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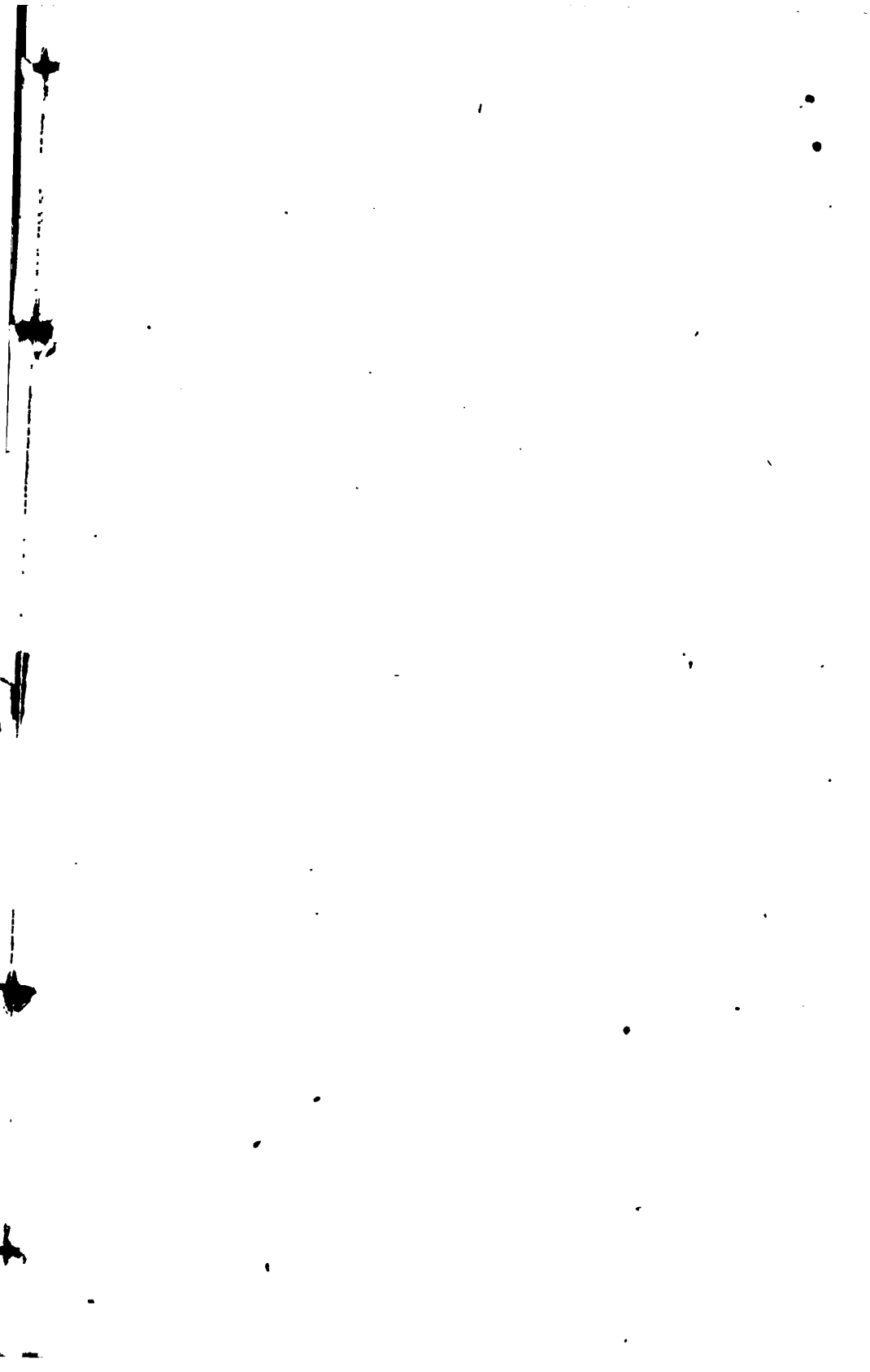
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No. 19. A.

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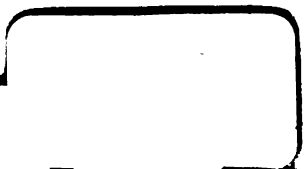
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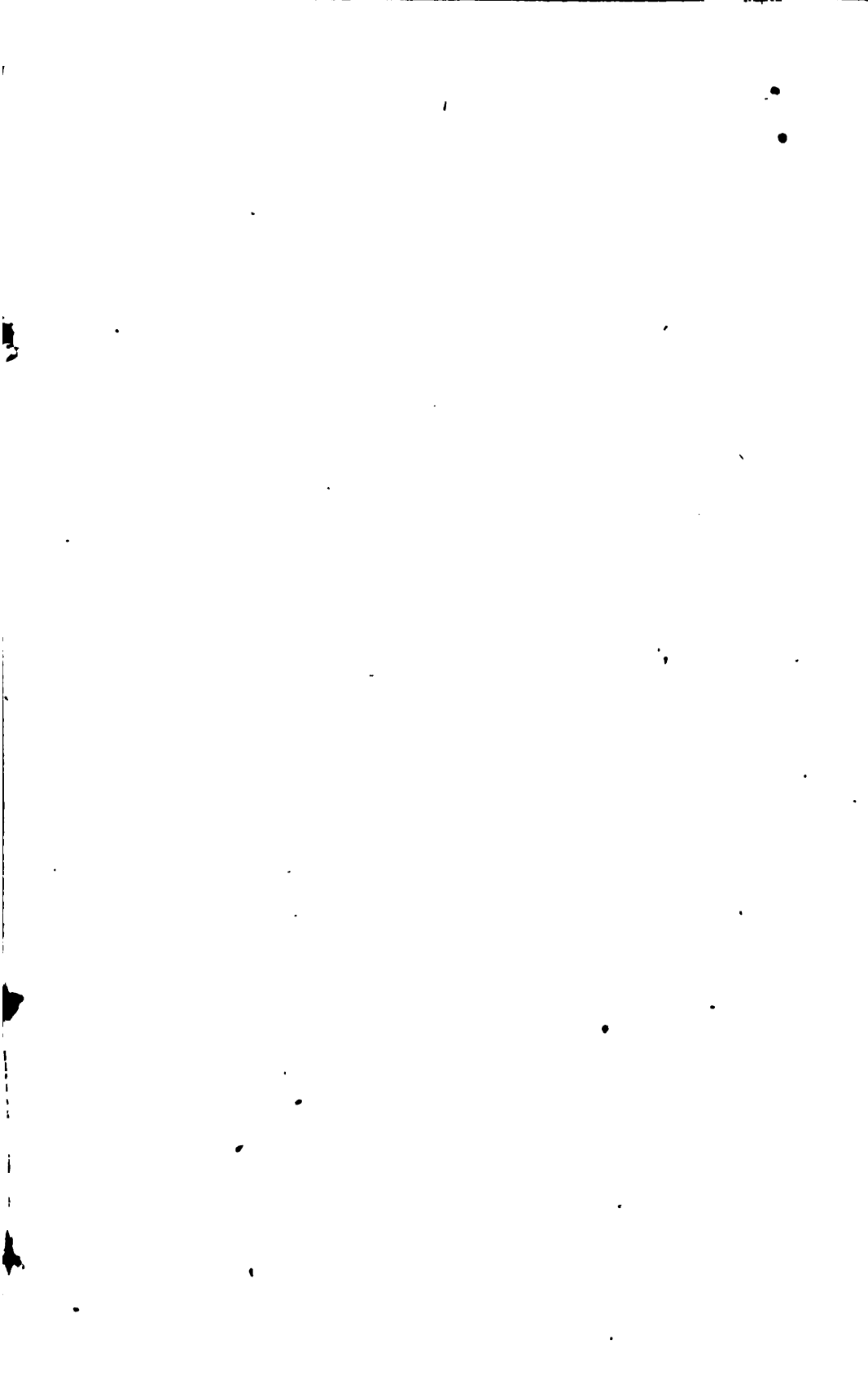


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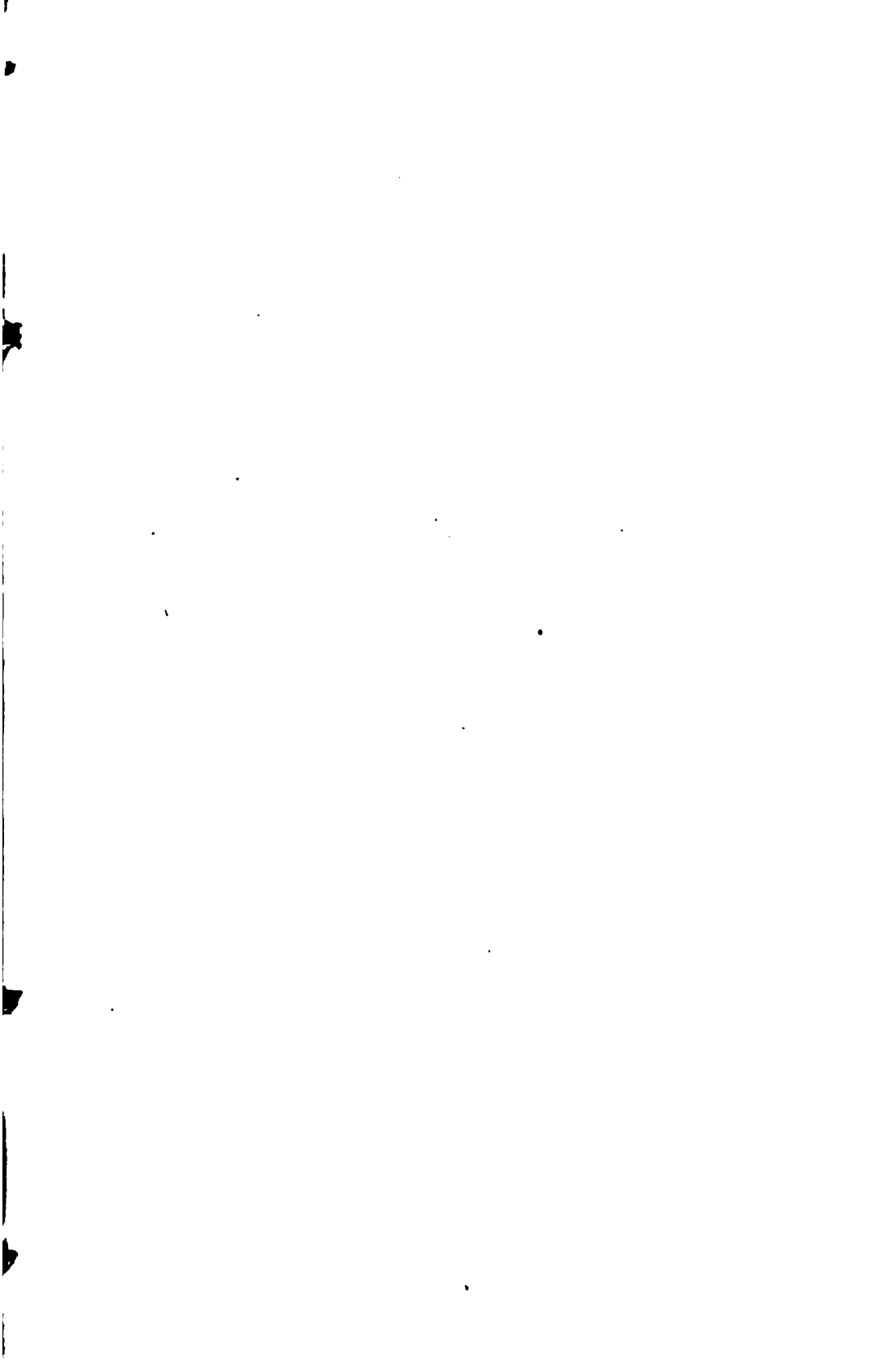
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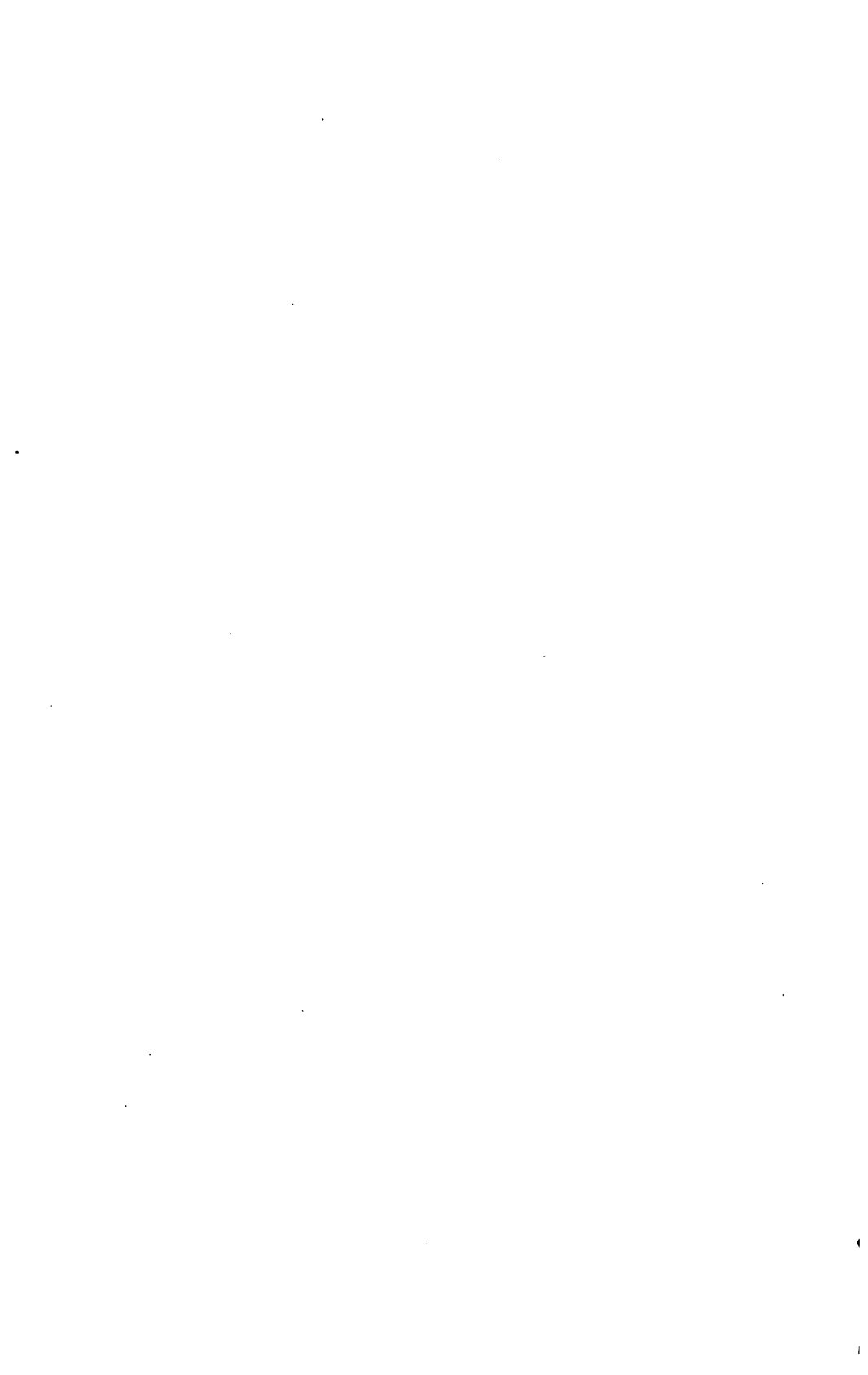
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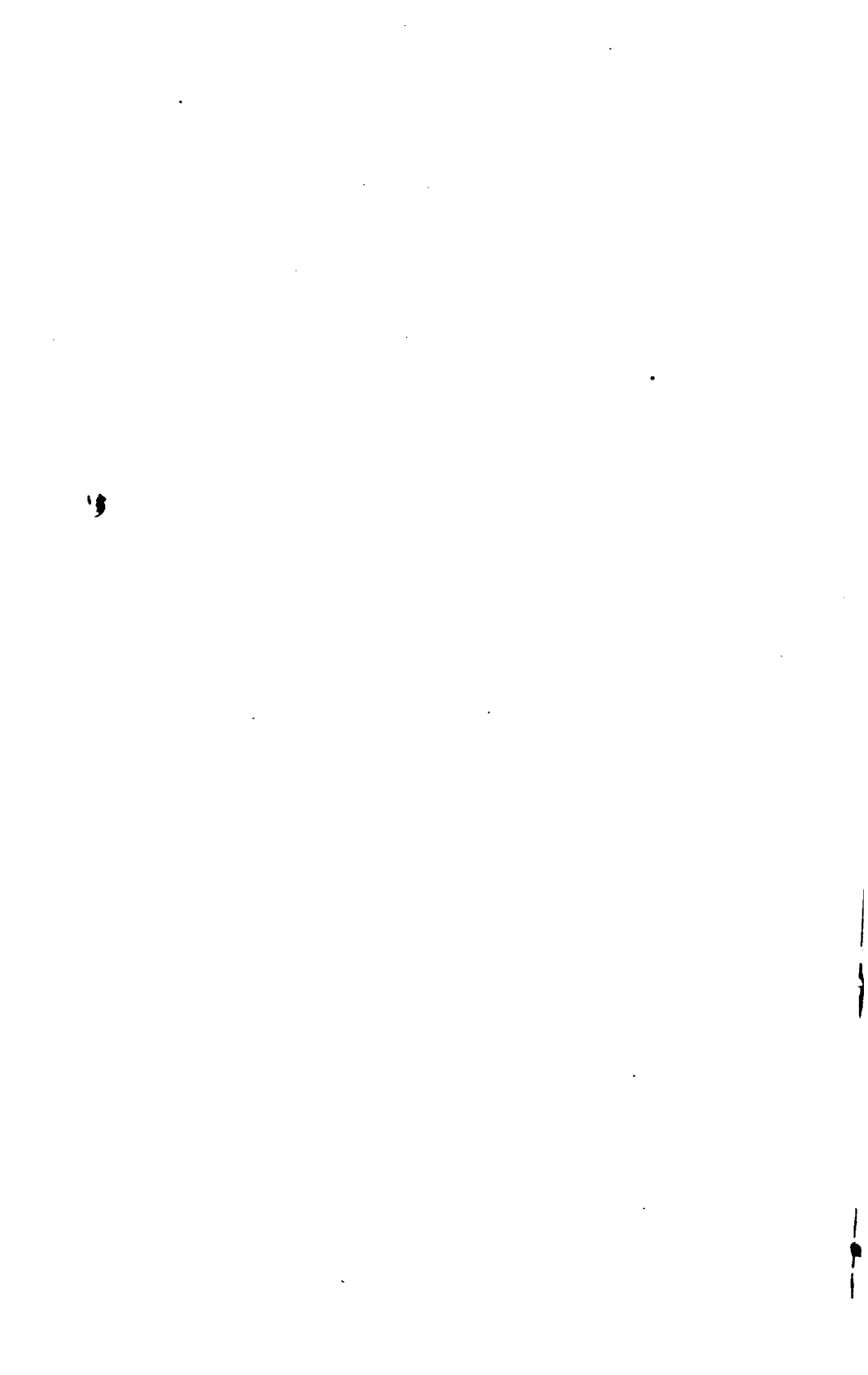






REPORT
OF THE
TESTS OF METALS
AND
OTHER MATERIALS
FOR
INDUSTRIAL PURPOSES,
MADE WITH THE
UNITED STATES TESTING MACHINE AT WATERTOWN ARSENAL,
MASSACHUSETTS,
DURING THE
FISCAL YEAR ENDED JUNE 30, 1903.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.



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LETTER

FROM .

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A COPY OF A COMMUNICATION FROM THE CHIEF OF ORD-
NANCE, A REPORT OF TESTS OF IRON AND STEEL AND OTHER
MATERIALS.

FEBRUARY 8, 1904.—Referred to the Committee on Manufactures and ordered to be
printed.

WAR DEPARTMENT,
Washington, February 5, 1904.

SIR: I have the honor to transmit herewith a letter of this date from
the Chief of Ordnance, U. S. Army, submitting for transmission to
Congress, as required by law, copy of the report of the commanding
officer at the Watertown Arsenal, of "Tests of iron and steel and other
material for industrial purposes," made at that arsenal during the
fiscal year ended June 30, 1903.

Very respectfully,

WM. H. TAFT,
Secretary of War.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, February 5, 1904.

SIR: I have the honor to submit, for transmission to Congress, as
required by law, a copy of the report of the commanding officer,
Watertown Arsenal, of "Tests of iron and steel and other material for
industrial purposes," made at that arsenal during the fiscal year ended
June 30, 1903, which has just been received at this office.

Very respectfully,

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

The SECRETARY OF WAR.

WATERTOWN ARSENAL,
Watertown, Mass., January 19, 1904.

SIR: I have the honor to submit herewith the annual report of tests of iron and steel, and other materials, made at this arsenal during the fiscal year ended June 30, 1903.

The total number of specimens tested during the year was classified as follows:

Gun specimens.....	71
For Ordnance Department.....	1,471
For other Government departments.....	178
Investigative tests.....	1,874
Tests for private parties.....	518
Total.....	4,112

The receipts and expenditures were as follows:

Amount appropriated for testing machine and testing work.....	\$15,000.00
Received from private parties during the year.....	816.25
Total received.....	15,816.25
Amount expended for services and labor.....	14,105.03
Amount expended for light, power, tools, implements, and materials for test.....	1,711.22
Total expended.....	15,816.25

During the past year the testing department has been occupied with material representing the current work at this arsenal and those manufacturing establishments which are engaged upon work for the Ordnance Department. The tests are directed chiefly toward the determination of those physical properties essential for the acceptance of the material, as prescribed in the specifications governing the manufacture of ordnance construction.

In certain of these tests the loading of the material is continued until rupture of the metal is effected and the maximum resistance thus ascertained, and the results compared with the predetermined properties established in the specifications. In other cases proof stresses have been applied, the maximum severity of which is adequate to demonstrate the fitness of the metal for its intended purpose, yet without causing sensible deformation or injury thereto. The proof tests of piston rods and the repeated loading of springs are examples of the latter class of tests, while in the former may be found the class of tensile tests consisting of the metal in guns and their carriages and mounts, or coupons therefrom.

A considerable number of tests on the tensile strength of metal from steel castings for 6-inch barbette mounts have formed a part of the work of the testing machines, nearly one thousand specimens from the steel castings having been prepared and tested during the past six months. These specimens, together with bronze, cast iron, and forged steel, from the arsenal shops, represent the larger part of the routine tests of specimens carried to ultimate destruction. Helical springs for different types and sizes of carriages have been tested and form another part of the routine work of the testing room.

In the investigation of the subject of streaks in gun forgings, a third hoop of reduced thickness of walls has been subjected to interior hydrostatic pressures, which were increased until rupture of the metal

was effected. The results of this, a streaked hoop, confirmed the earlier tests of a section of the same metal in respect to showing that streaks are lines of diminished resistance in the steel.

Tests of shrapnel cases have been made, showing the tensile strength of cold-drawn cylindrical and hexagonal cases, and the strength of Ehrhardt cases; also, tests by interior bursting pressures.

Respecting the investigation of the relative properties of carbon and nickel steels, current statements on these steels have met with further confirmation in the present series of tests; that is, that higher elastic limits and tensile strength, still accompanied by toughness, results from the addition of nickel to the metal. Under repeated alternate stresses of tension and compression the two steels behave in a similar manner, and ultimate rupture may be accomplished in each without the display of sensible elongation or contraction of area. The properties of a given steel are so modified by heat and mechanical treatment that special attention has been given the metal as found in its natural state in the ingot. In this state, as exemplified in the present tests, attention has been directed to the presence of local spots of weakness which, in the specimens thus far tested (extracted from apparently sound parts of the unforged ingot), have been more frequently encountered in the nickel steel ingot than in the carbon steel. These local defects appear, after the metal has been ruptured, as bands or streaks of light-colored metal, with smooth, splendid surfaces. Their presence has not yet been explained. So far as known heat treatment of the unforged metal by annealing at a suitable temperature, while improving the metal as a whole, does not modify the deleterious influence of these local defects. Forging tends to obliterate and obscure defects of this kind, at least in tests made in the direction in which the metal has been drawn out by the hammer.

Illustrating the range of physical properties which may be displayed by the same grade of steel, sound metal from a nickel steel ingot, Ni. 3.25, C. 0.17, showing in its natural state a tensile strength of 66,000 pounds per square inch, was raised by means of heat treatment, without forging, to a maximum of 189,000 pounds per square inch. This result was attained by sudden quenching of the steel from a high temperature. Heating and quenching from a more moderate temperature resulted in the acquisition of an elastic limit equal or superior to the primitive tensile strength of the unforged metal, concomitant with the ability to elongate and contract well before rupture.

Experiments have been made, confirming earlier results from other sources, on the effect of torsional strains, carried beyond the elastic limit of the metal, upon the subsequent tensile properties. Overstraining in a tensile direction followed by a period of rest, as is well known, causes an exaltation of the elastic limit and increase in ultimate tensile strength. The torsional overstrain, although stretching some of the fibers, shortened the bar as a whole. This resulted in a decided increase in tensile strength; the greater the number of twists the higher the tensile strength of the specimen turned down from the twisted bar. A 50,000-pound iron was raised to a strength of 67,000 pounds per square inch. In respect to the elastic limit and elongation, both had lower values in the twisted metal, the former value being quite indefinite.

There was an examination of some old iron and steel bars after a long interval of time had elapsed since the original tests were made.

The fractured ends from some double refined puddled iron bars rested a period of twenty years four months, at the end of which time they were again loaded in tension. The high state of tensile resistance incident to the primitive stretching of the metal still remained in the bars. That is, there had been no effacement by reason of the lapse of time of the high tensile elastic limit which followed the earlier overstraining of the iron. Under the opposite stresses of compression there was likewise a high resistance before permanent sets were developed. In another instance a steel bar was examined after an interval of rest of fourteen years five months. This examination was for the purpose of determining the present value of the elastic limit of the metal for loads in a compressive direction, the last loading having been an overstraining one in a tensile direction. From previous results with this bar the immediate effect of overstraining in one direction was attended with a considerable reduction in the elastic limit under reversed stresses. The apparent result of the interval of rest was a tendency toward the restoration of a state of equality between the tensile and compressive elastic limits. This was not completely reestablished, but an advancement toward this result was shown.

Investigative tests on the subject of cements and concretes have been continued, and the results developed are believed to possess general engineering interest. Some tests have been made on neat Portland cement and cement mortar, the latter having the composition of one part cement to one part sand, in which the material was set under pressure immediately after gauging. The neat cement specimen at the age of 1 month displayed a compressive strength of 19,150 pounds per square inch—the average strength of granite—and the mortar specimen at the same age 14,020 pounds per square inch. During the early stages of induration, and while in the molds, the material was placed under an initial pressure of about 14,000 pounds per square inch, after the release of which the specimen set in water until tested. The strength developed by these specimens was largely in excess of that of corresponding material which indurated under normal conditions of setting.

Very respectfully, your obedient servant,

JOHN G. BUTLER,

Colonel, Ordnance Department, U. S. Army, Commanding.

The CHIEF OF ORDNANCE, U. S. ARMY,
Washington, D. C.

REPORT
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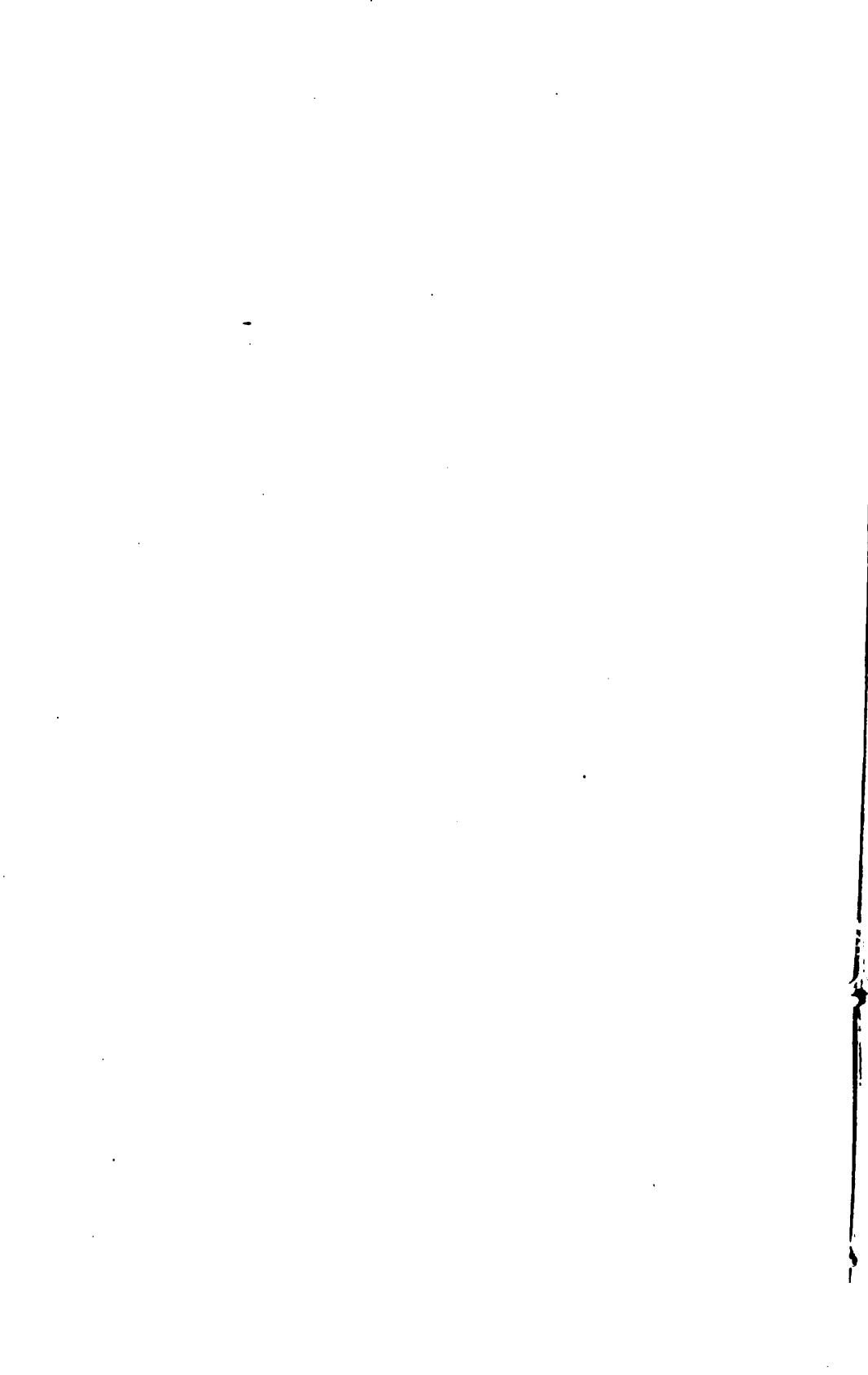
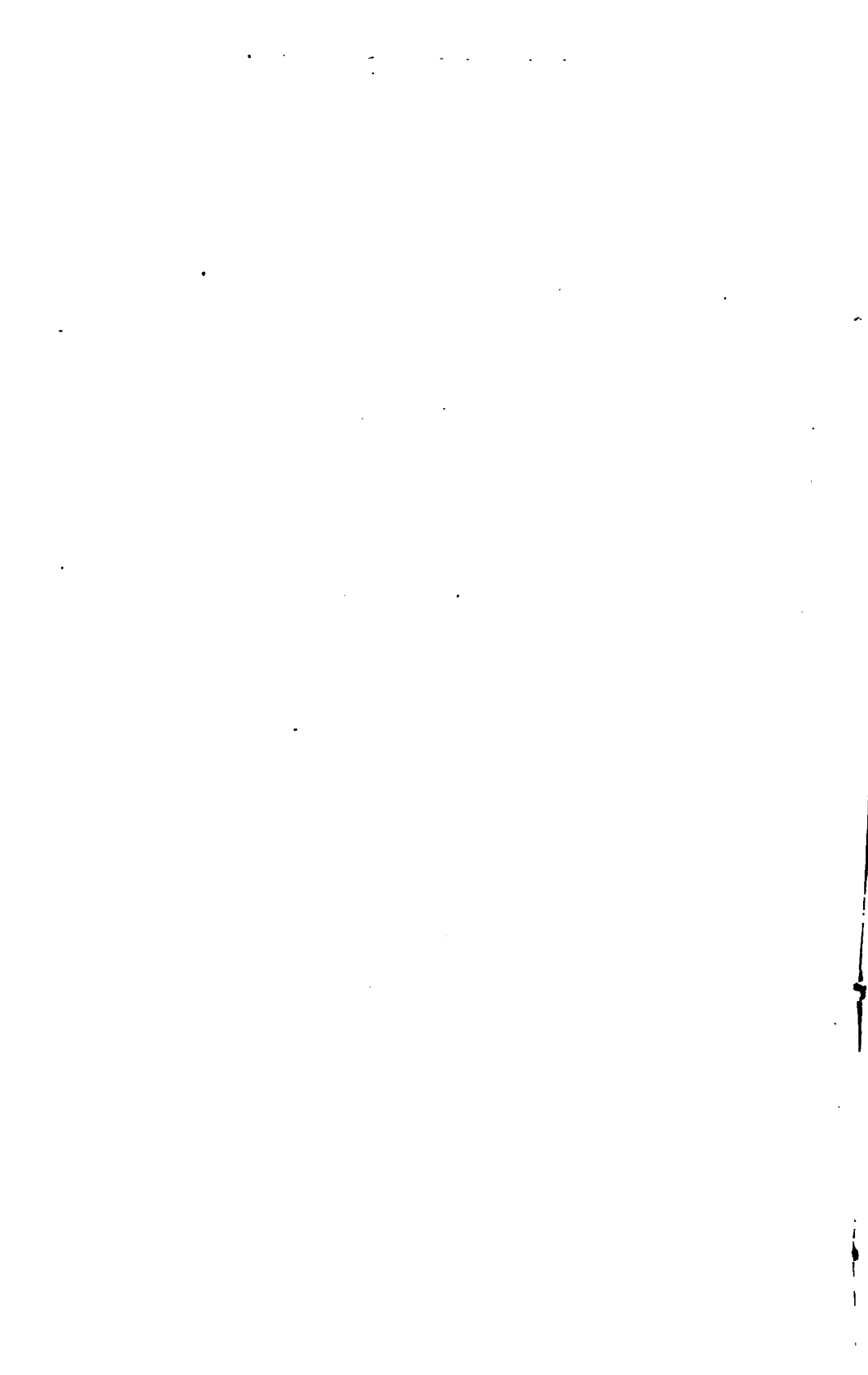


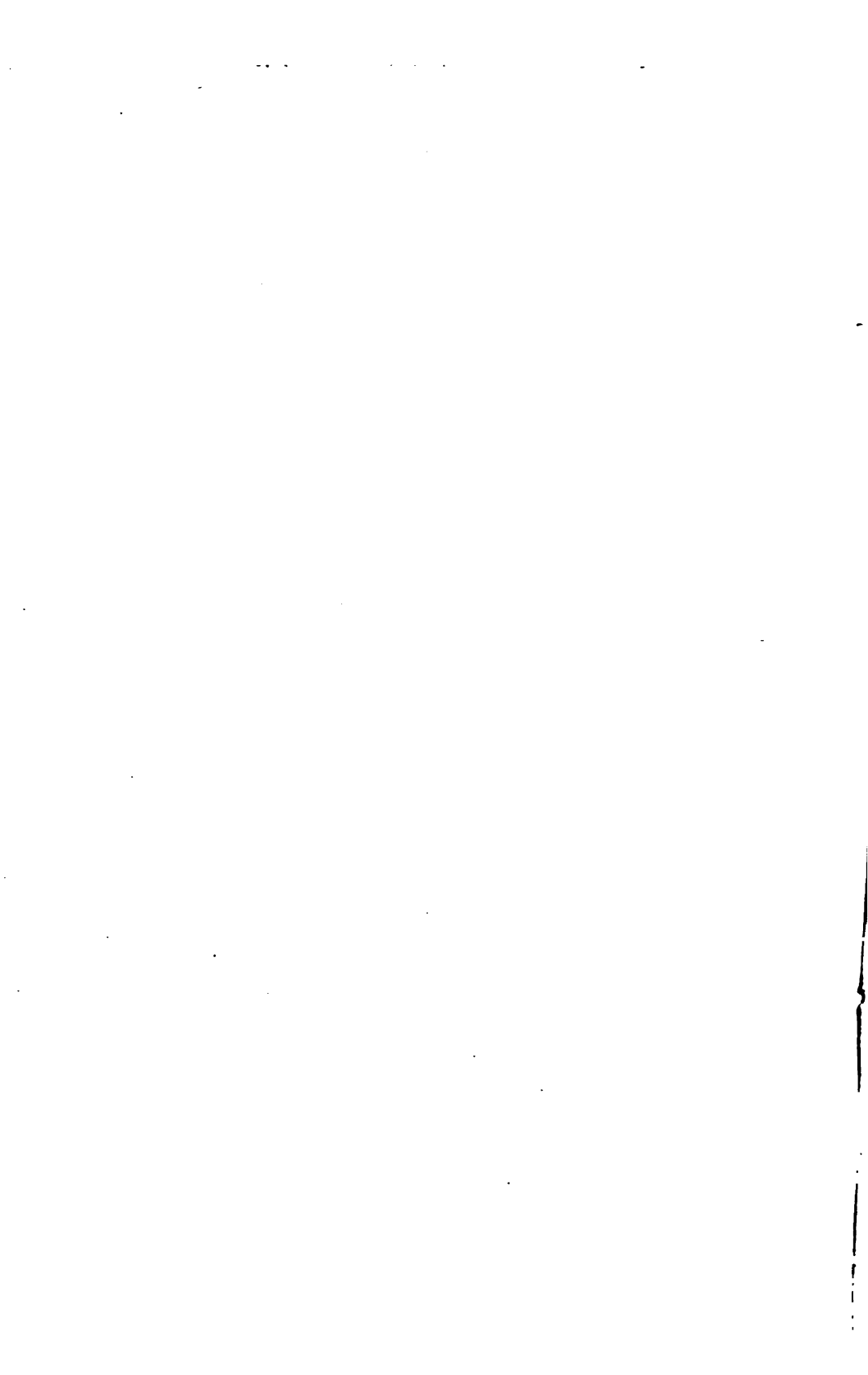
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15-POUNDER R. F. GUNS.

**SPECIMENS FROM TUBES, JACKETS, BREECHBLOCK,
AND BREECH BUSHING.**



TUBE.

No. 7618.

Marks, ^{S1962 B, F1}
B T, M

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
Pounds.	Inch.	Inch.	Inch.	Inch.		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.00010	.00010	0.	0.		
10,000	.00080	.00020	.....	.....
20,000	.00065	.00085	.....	.....
30,000	.00100	.00085	.....	.....
35,000	.00120	.00020	0.	0.		
40,000	.00145	.00025	0.	0.		
45,000	.00160	.00015	.....	.....
50,000	.00180	.00020	.....	.....
55,000	.00205	.00025	.....	.....
56,000	.00215	.00010	Elastic limit.	
57,000	.00400	.00185	.....	.....
58,000	.00675	.00475	.....	.....
59,000	.00920	.00045	.....	.....
60,000	.00970	.00050	.....	.....
61,000	.01085	.00115	.....	.....
62,000	.01150	.00065	.....	.....
95,500		Tensile strength.

General summary.

Tensile strength per square inch of original section.....	pounds..	95,500
Elastic limit per square inch of original section.....	do...	56,000
Elongation per inch after rupture.....	inch..	.205
Elongation per inch under strain at elastic limit.....	do...	.00215
Reduction in diameter at point of rupture.....	do...	.105
Reduction in area after rupture, per cent of original section.....		37.1
Position of rupture.....		" .55 from neck
Character of broken surface.....		silky, trace of granulation
Elongation of inch sections.....		" .12, ".29*

TUBE.

No. 7681.

Marks, ^{31953 B, F₁}
_{B T, M}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00085	.00020	0.	0.	
20,000	.00070	.00035	0.	0.	
30,000	.00110	.00040	0.	0.	
35,000	.00125	.00015	0.	0.	
40,000	.00145	.00020	0.	0.	
42,000	.00150	.00005	0.	0.	
50,000	.00180	.00030			
55,000	.00200	.00020			
56,000	.00205	.00005			Elastic limit.
57,000	.00250	.00045			
58,000	.00305	.00055			
59,000	.00370	.00065			
60,000	.00450	.00080			
61,000	.00625	.00175			Tensile strength.
98,500					

General summary.

Tensile strength per square inch of original sectionpounds.. 98,500
 Elastic limit per square inch of original sectiondo... 56,000
 Elongation per inch after ruptureinch... .19
 Elongation per inch under strain at elastic limitdo... .00205
 Reduction in diameter at point of rupturedo... .185
 Reduction in area after rupture, per cent of original sectiondo... 46.2
 Position of rupture ".45 from neck
 Character of broken surface silky
 Elongation of inch sections ".27", ".11

TUBE.

No. 7726.

Marks, ^{31969 B, F,}
B T, M

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00085	.00025	.....	.....
20,000	.00065	.00080	.....	.....
30,000	.00106	.00040	.....	.....
35,000	.00120	.00015	.00005	.00005	Elastic limit.
40,000	.00145	.00025	.....	.....
42,000	.00150	.00005	.00005	0.	
50,000	.00185	.00085	.....	.....
51,000	.01025	.00840	.....	.....
52,000	.01110	.00085	.....	.....
53,000	.01190	.00080	.....	.....
54,000	.01275	.00085	.....	.....
55,000	.01375	.00100	.....	.....
89,400	

General summary.

Tensile strength per square inch of original section	pounds..	89,400
Elastic limit per square inch of original section	do...	50,000
Elongation per inch after rupture	inch..	.24
Elongation per inch under strain at elastic limit.....	do...	.00185
Reduction in diameter at point of rupture.....	do...	.125
Reduction in area after rupture, per cent of original section .....	.....	43.3
Position of rupture	"	.8 from neck
Character of broken surface.....	.....	fine silky
Elongation of inch sections	"	.15, ".35*

TUBE.

No. 7771.

Marks, ^{82311 B, F₁}
_{B T₂ M}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00040	.00030	.....	.....
20,000	.00070	.00030	.....	.....
30,000	.00105	.00085	.....	.....
40,000	.00135	.00080	0.	0.	
42,000	.00140	.00005	0.	0.	
50,000	.00165	.00025	.....	.....
56,000	.00190	.00025	.....	.....
57,000	.00250	.00060	.....	.....
58,000	.00450	.00200	Elastic limit.
59,000	.00650	.00200	.....	.....
60,000	.00950	.00800	.....	.....
61,000	.01175	.00225	.....	.....
91,100	Tensile strength.

General summary.

Tensile strength per square inch of original section.....pounds.. 91,100
 Elastic limit per square inch of original section.....do... 56,000
 Elongation per inch after rupture.....inch... .24
 Elongation per inch under strain at elastic limit.....do... .00190
 Reduction in diameter at point of rupture.....do... .135
 Reduction in area after rupture, per cent of original section..... 46.2
 Position of rupture..... 1" from neck
 Character of broken surface..... silky
 Elongation of inch sections.....".85", ".13

JACKET.

No. 7662.

Marks, ^{3296 B, F₁}
B T₁ M

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00045	.00090	.....	.....
20,000	.00090	.00185	.....	.....
30,000	.00100	.00200	.....	.....
40,000	.00113	.00213	0.	0.	Tensile strength.
45,000	.00135	.00222	0.	0.	
48,000	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original sectionpounds.. 48,000
 Elongation per inch after rupture inch.. .005
 Reduction in diameter at point of rupture..... inappreciable
 Reduction in area after rupture, per cent of original section inappreciable
 Position of rupture..... at the neck
 Character of broken surface.....granular 45 per cent, serrated 55 per cent, fractured at a streak of
 serrated metal ".3 deep.
 Elongation of inch sections.....".01, ".00

JACKET.

No. 7663.

Marks, ^{35729 B,}
B T, M¹
Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.00010	.00010	0.	0.		
10,000	.00035	.00025	.....	.....
20,000	.00065	.00080	.....	.....
30,000	.00100	.00035	.....	.....
40,000	.00135	.00035	0.	0.		
46,000	.00160	.00025	0.	0.		
56,000	.00200	.00040	.....	.....
57,000	.00205	.00005		Elastic limit.
58,000	.00895	.00690	.....	.....
59,000	.00960	.00065	.....	.....
60,000	.01050	.00090	.....	.....
61,000	.01140	.00090	.....	.....
62,000	.01260	.00120	.....	.....
92,000	Tensile strength.	

General summary.

Tensile strength per square inch of original section	pounds..	92,000
Elastic limit per square inch of original section	do...	57,000
Elongation per inch after rupture	inch..	.22
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture	1" from neck	
Character of broken surface	silky, oblique	
Elongation of inch sections	" .29", "	.15

JACKET.

No. 7665.

Marks, ^{85636 E₁}
B T, M

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00040	.00025	.....	.....
20,000	.00070	.00030	.....	.....
30,000	.00105	.00035	.....	.....
40,000	.00135	.00030	0.	0.	Elastic limit.
46,000	.00160	.00025	0.	0.	
58,000	.00210	.00060	.....	.....
59,000	.00550	.00840	.....	.....
60,000	.00800	.00250	.....	.....
61,000	.00900	.00100	Tensile strength.
62,000	.01025	.00125	.....	.....
63,000	.01140	.00115	.....	.....
95,100	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section	pounds..	95,100
Elastic limit per square inch of original section	do...	58,000
Elongation per inch after rupture	inch..	.285
Elongation per inch under strain at elastic limit	do...	.00210
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture	"	.86 from neck
Character of broken surface		silky
Elongation of inch sections	"	.34*, ".13

JACKET.

No. 7671.

Marks, ^{81483 B,}
B T, M

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.00010	.00010	0.	0.		
10,000	.00040	.00080	.....	.....
20,000	.00075	.00085	.....	.....
30,000	.00105	.00080	.....	.....
40,000	.00140	.00085	0.	0.		
46,000	.00170	.00080	0.	0.		
47,000	.00175	.00005		Elastic limit.
48,000	.00300	.00125	.....	.....
49,000	.00545	.00245	.....	.....
50,000	.00700	.00155	.....	.....
51,000	.00800	.00100	Tensile strength.	
52,000	.00890	.00090	.....	.....
90,500		

General summary.

Tensile strength per square inch of original section pounds. 90,500
 Elastic limit per square inch of original section do. 47,000
 Elongation per inch after rupture inch. 16
 Elongation per inch under strain at elastic limit do. .00175
 Reduction in diameter at point of rupture do. .065
 Reduction in area after rupture, per cent of original section 28.9
 Position of rupture "7 from neck.
 Character of broken surface granular 60 per cent, silky 40 per cent, opened cracks in the surface
 of the stem.
 Elongation of inch sections ".22,* "10

JACKET.

No. 7691.

Marks, ^{36125 B, F₁}
_{B T, M}
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00085	.00025	.....	.....
20,000	.00070	.00085	.....	.....
30,000	.00105	.00085	.....	.....
40,000	.00140	.00085	0.	0.	Elastic limit.
45,000	.00160	.00020	0.	0.	
55,000	.00205	.00045	.....	.....
58,000	.01175	.00970	.....	.....
60,000	.01210	.00035	.....	.....
61,000	.01250	.00040	Tensile strength.
62,000	.01350	.00100	.....	.....
63,000	.01475	.00125	.....	.....
94,100	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....	pounds..	94,100
Elastic limit per square inch of original section.....	do..	58,000
Elongation per inch after rupture.....	inch..	.255
Elongation per inch under strain at elastic limit.....	do..	.00205
Reduction in diameter at point of rupture.....	do..	.185
Reduction in area after rupture, per cent of original section.....		46.2
Position of rupture.....	at the middle of the stem	
Character of broken surface.....	silky	
Elongation of inch sections.....	"28" "28"	

BREECHBLOCK.

No. 7670.

Marks, ^{19053 B, F₁₀}
T, M.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00040	.00025	0.	0.	
20,000	.00075	.00085	0.	0.	
30,000	.00105	.00080	0.	0.	
40,000	.00140	.00035	0.	0.	
45,000	.00165	.00025	0.	0.	
60,000	.00210	.00045			
65,000	.00240	.00030			
70,000	.00250	.00010			
75,000	.00270	.00020			Elastic limit.
76,000	.00285	.00015			
77,000	.00950	.00665			
78,000	.01085	.00085			
79,000	.01100	.00065			
80,000	.01190	.00090			Tensile strength.
119,700					

General summary.

Tensile strength per square inch of original section	pounds..	119,700
Elastic limit per square inch of original section	do...	75,000
Elongation per inch after rupture	inch...	.205
Elongation per inch under strain at elastic limit	do...	.00270
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.8
Position of rupture	at the middle of the stem	
Character of broken surface	fine silky	
Elongation of inch sections	".22", ".19"	

15-POUNDER R. F. GUNS.

BREECH BUSHING.

No. 7669.

Marks, 19166 B, F₁

B T, M
Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	Inch.	Inch.	Inch.	Inch.	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00040	.00025	.....	.....
20,000	.00080	.00040	.....	.....
30,000	.00110	.00080	.....	.....
40,000	.00145	.00085	0.	0.	Elastic limit.
46,000	.00180	.00085	0.	0.	
50,000	.00280	.00050	.....	.....
61,000	.00225	.00095	.....	.....
62,000	.01085	.00110	.....	.....
63,000	.01080	.00025	Tensile strength.
64,000	.01150	.00090	.....	.....
65,000	.01205	.00055	.....	.....
104,200	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....pounds.. 10
 Elastic limit per square inch of original section.....do... 6
 Elongation per inch after rupture.....inch.....
 Elongation per inch under strain at elastic limit.....do...
 Reduction in diameter at point of rupture.....do...
 Reduction in area after rupture, per cent of original section.....
 Position of rupture..... 1" from
 Character of broken surface.....
 Elongation of inch sections.....".15,

TABULATION OF TENSION SPECIMENS FROM 15-POUNDER R. F. G
 STEMS 2" LONG, ".506 DIAMETER.

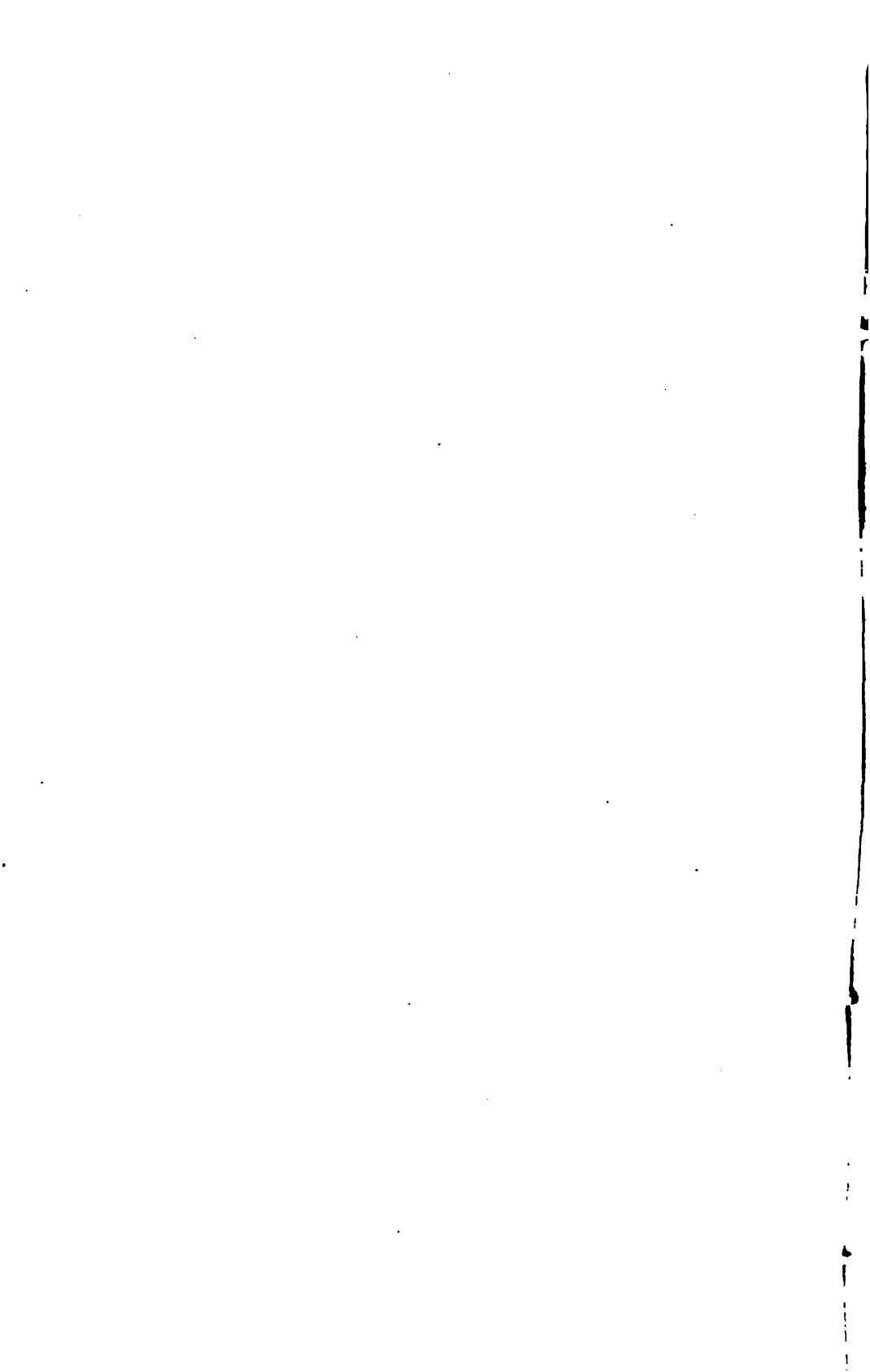
No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks
			Pounds.	Pounds.	Per ct.	Per ct.		
7618	Tube	Middle	56,000	96,500	20.5	37.1	Silky, trace of granulation.	Breech end.
7681	.....do.....	.....do.....	56,000	98,500	19.0	46.2	Silky.....	Do.
7726	.....do.....	.....do.....	50,000	89,400	24.0	43.3	Fine silky	Do.
7771	.....do.....	.....do.....	56,000	91,100	24.0	46.2	Silky.....	Do.
7662	Jacket.....	.....do.....	.....	48,000	0.5	(a)	Granular, 45 per cent; serrated, 55 per cent. Fractured at a streak of serrated metal #3 deep.	Do.
7663	.....do.....	.....do.....	57,000	92,000	22.0	43.3	Silky, oblique...	Do.
7665	.....do.....	.....do.....	58,000	95,100	23.5	46.2	Silky.....	Do.
7671	.....do.....	.....do.....	47,000	90,500	16.0	23.9	Granular, 60 per cent; silky, 40 per cent. Opened cracks in the surface of the stem.	Do.
7691	.....do.....	.....do.....	58,000	94,100	25.5	46.2	Silky.....	Do.
7670	Breechblock .....	.....do.....	75,000	119,700	20.5	40.3	Fine silky	Do.
7669	Breech bushing .....	.....do.....	60,000	104,200	22.5	40.3	Silky.....	

(a) Inappreciable.



75-MILLIMETER MOUNTAIN GUNS.

BODIES AND BREECHBLOCKS.



BODY.

No. 7486.

Marks, ¹¹⁸⁻⁴_{BM}
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00040	.00025	.....	.....
20,000	.00085	.00045	.....	.....
30,000	.00110	.00025	.....	.....
35,000	.00135	.00025	0.	0.	
40,000	.00145	.00010	.....	.....
42,000	.00150	.00005	0.	0.	
49,000	.00190	.00040	.....	.....
50,000	.00200	.00010	.....	.....		Elastic limit.
51,000	.00205	.00005	.....	.....
52,000	.00340	.00135	.....	.....
53,000	.00400	.00060	.....	.....
54,000	.00510	.00110	.....	.....
55,000	.00560	.00050	.....	.....
56,000	.00675	.00115	Tensile strength.
97,550	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....pounds.. 97,550
 Elastic limit per square inch of original section.....do.. 51,000
 Elongation per inch after rupture.....inch.. .21
 Elongation per inch under strain at elastic limit.....do.. .00205
 Reduction in diameter at point of rupture.....do.. .105
 Reduction in area after rupture, per cent of original section..... 37.1
 Position of rupture....." .95 from neck
 Character of broken surface..... silky, trace of granulation
 Elongation of inch sections....." .13, ".29"

BODY.

No. 7487.

Marks, ⁶⁴BI

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00080	.00020	.....	.....
20,000	.00060	.00080	.....	.....
30,000	.00095	.00085	.....	.....
35,000	.00105	.00010	0.	0.	
40,000	.00130	.00025	.....	.....
42,000	.00140	.00010	0.	0.	
50,000	.00170	.00080	.....	.....
51,000	.00175	.00005	.....	.....		Elastic limit.
52,000	.00180	.00005	.....	.....
53,000	.00290	.00110	.....	.....
54,000	.00400	.00110	.....	.....
55,000	.00500	.00100	.....	.....
56,000	.00600	.00100	.....	.....
57,000	.00710	.00110	.....	.....
96,200	Tensile strength.

General summary.

Tensile strength per square inch of original section pounds.. 96,200
 Elastic limit per square inch of original section do... 52,000
 Elongation per inch after rupture inch... .19
 Elongation per inch under strain at elastic limit do... .00180
 Reduction in diameter at point of rupture..... do... .085
 Reduction in area after rupture, per cent of original section 30.7
 Position of rupture " 96 from neck
 Character of broken surface granular 80 per cent, silky lamellar 20 per cent
 Elongation of inch sections " 14, " 24*

Body.

No. 7489.

Marks, ¹¹⁸⁻³_{BM}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
Pounds.	Inch.	Inch.	Inch.	Inch.		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.00010	.00010	0.	0.		
10,000	.00080	.00020	.....	.....
20,000	.00080	.00080	.....	.....
30,000	.00095	.00085	.....	.....
35,000	.00115	.00020	0.	0.		
40,000	.00140	.00025	.....	.....
42,000	.00150	.00010	0.	0.		
49,000	.00170	.00020		Elastic limit.
50,000	.00180	.00010	.....	.....
51,000	.00200	.00020	.....	.....
52,000	.00405	.00205	.....	.....
53,000	.00600	.00195	.....	.....
54,000	.00760	.00180	.....	.....
90,300	Tensile strength.	

General summary.

Tensile strength per square inch of original section	pounds..	90,300
Elastic limit per square inch of original section	do...	49,000
Elongation per inch after rupture	inch..	.23
Elongation per inch under strain at elastic limit	do...	.00170
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture	1".16 from neck	
Character of broken surface	silky	
Elongation of inch sections	" .39", "	.16

Body.

No. 7546.

Marks, ¹²⁵⁻⁷¹_{B M T}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	.....	.....
20,000	.00060	.00025	.....	.....
30,000	.00100	.00040	.....	.....
35,000	.00115	.00015	0.	0.	Elastic limit.
40,000	.00135	.00020	.....	.....
42,000	.00145	.00010	0.	0.	
47,000	.00165	.00020	.....	.....
48,000	.00195	.00080	.....	.....
49,000	.00410	.00215	.....	.....
50,000	.00560	.00140	.....	.....
51,000	.00650	.00100	Tensile strength.
52,000	.00785	.00115	.....	.....
89,050	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original sectionpounds.. 89,050
 Elastic limit per square inch of original sectiondo... 47,000
 Elongation per inch after ruptureinch... .185
 Elongation per inch under strain of elastic limitdo... .00165
 Reduction in diameter at point of rupture.....do... .085
 Reduction in area after rupture, per cent of original section..... 30.7
 Position of rupture 1".17 from neck
 Character of broken surface granular, 70 per cent; silky, 30 per cent
 Elongation of inch sections..... ".20*, ".17

BODY.

No. 7547.

Marks, ¹⁵⁸⁻³ B M T
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00085	.00025	.....	.....
20,000	.00065	.00080	.....	.....
30,000	.00105	.00040	.....	.....
35,000	.00115	.00010	0.	0.	Elastic limit.
40,000	.00140	.00025	.....	.....
42,000	.00145	.00005	0.	0.	
55,000	.00210	.00065	.....	.....
56,000	.00225	.00025	.....	.....
57,000	.00400	.00165	.....	.....
58,000	.00490	.00090	.....	.....
59,000	.00570	.00080	.....	.....
60,000	.00685	.00115	.....	.....
99,500	

General summary.

Tensile strength per square inch of original section	pounds..	99,500
Elastic limit per square inch of original section	do...	55,000
Elongation per inch after rupture	inch..	.196
Elongation per inch under strain at elastic limit	do...	.00210
Reduction in diameter at point of rupture	do...	.105
Reduction in area after rupture, per cent of original section		37.1
Position of rupture		1" from neck
Character of broken surface		granular, 50 per cent; silky, 50 per cent
Elongation of inch sections		".24*, ".15

BODY.

No. 7560.

Marks, ¹⁵²⁻³_{BT}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00080	.00020	.....	.....
20,000	.00060	.00080	.....	.....
30,000	.00085	.00085	.....	.....
35,000	.00110	.00015	0.	0.	
40,000	.00185	.00025	.....	.....
42,000	.00145	.00010	0.	0.	
50,000	.00175	.00080	.....	.....
51,000	.00180	.00005	.....	.....
52,000	.00190	.00010	Elastic limit.
53,000	.00200	.00010	.....	.....
54,000	.00250	.00050	.....	.....
55,000	.00370	.00120	.....	.....
56,000	.00415	.00045	.....	.....
57,000	.00505	.00090	.....	.....
58,000	.00640	.00135	Tensile strength.
99,100	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section..... pounds.. 99,100
 Elastic limit per square inch of original section..... do... 58,000
 Elongation per inch after rupture..... inch... .190
 Elongation per inch under strain at elastic limit..... do... .00200
 Reduction in diameter at point of rupture..... do... .105
 Reduction in area after rupture, per cent of original section..... 87.1
 Position of rupture..... 1⁷/₁₆ from neck
 Character of broken surface..... silky, oblique, trace of granulation
 Elongation of inch sections..... "23", "15

Body.

No. 7561.

Marks, ¹⁵⁸⁻³_{B L}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00085	.00025	.....	.....
20,000	.00080	.00025	.....	.....
30,000	.00100	.00040	.....	.....
35,000	.00110	.00010	0.	0.	Elastic limit.
40,000	.00135	.00025	.....	.....
42,000	.00145	.00010	0.	0.	
55,000	.00190	.00045	.....	.....
56,000	.00800	.00110	.....	.....
57,000	.00425	.00125	Tensile strength.
58,000	.00680	.00155	.....	.....
59,000	.00885	.00085	.....	.....
60,000	.00750	.00085	.....	.....
98,000	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....	pounds..	98,000
Elastic limit per square inch of original section.....	do..	56,000
Elongation per inch after rupture.....	inch..	.25
Elongation per inch under strain at elastic limit.....	do..	.00190
Reduction in diameter at point of rupture.....	do..	.175
Reduction in area after rupture, per cent of original section.....		57.2
Position of rupture.....		".75 from neck
Character of broken surface.....		fine silky
Elongation of inch sections.....		".38", ".12

BODY.

No. 7606.

Marks, ²⁻³ BMT

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2'.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00040	.00025	.....	.....
20,000	.00085	.00045	.....	.....
30,000	.00105	.00020	.....	.....
35,000	.00135	.00080	0.	0.	Elastic limit.
40,000	.00150	.00015	.....	.....
42,000	.00160	.00010	0.	0.	
50,000	.00195	.00035	.....	.....
55,000	.00220	.00025	.....	.....
57,000	.00240	.00020	.....	.....
58,000	.00550	.00810	.....	.....
59,000	.00750	.00200	.....	.....
60,000	.00940	.00190	.....	.....
61,000	.01050	.00110	.....	.....
95,500	Tensile strength.

General summary.

Tensile strength per square inch of original sectionpounds.. 95,500
 Elastic limit per square inch of original sectiondo... 56,000
 Elongation per inch after ruptureinch... .20
 Elongation per inch under strain at elastic limitdo... .00220
 Reduction in diameter at point of rupture.....do... .125
 Reduction in area after rupture, per cent of original sectiondo... 43.8
 Position of rupture 1".2 from neck
 Character of broken surface silky
 Elongation of inch sections ".25*, ".15

BODY.

No. 7667.

Marks, B M T¹⁻⁶

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
Pounds.	Inch.	Inch.	Inch.	Inch.		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.00015	.00015	0.	0.		
10,000	.00040	.00025	.....	.....
20,000	.00080	.00040	.....	.....
30,000	.00110	.00060	0.	0.		
35,000	.00125	.00025	.....	.....
40,000	.00150	.00015	0.	0.		
42,000	.00160	.00010	.....	.....
50,000	.00190	.00080	.....	.....
56,000	.00220	.00080		Elastic limit.
57,000	.00225	.00015	.....	.....
58,000	.00270	.00085	.....	.....
59,000	.00700	.00480	.....	.....
60,000	.01000	.00800	.....	.....
61,000	.01100	.00100	.....	.....
95,200	Tensile strength.	

General summary.

Tensile strength per square inch of original section	pounds..	95,200
Elastic limit per square inch of original section	do..	56,000
Elongation per inch after rupture	inch..	.19
Elongation per inch under strain at elastic limit	do..	.00230
Reduction in diameter at point of rupture	do..	.095
Reduction in area after rupture, per cent of original section		84
Position of rupture		1".3 from neck
Character of broken surface		silky
Elongation of inch sections		".22", ".16

BODY.

No. 7668.

Marks, ²⁻⁵ B M T

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00085	.00025	.....	.....
20,000	.00075	.00040	.....	.....
30,000	.00106	.00080	.....	.....
35,000	.00130	.00025	0.	0.	
40,000	.00150	.00020	.....	.....
42,000	.00155	.00006	0.	0.	
50,000	.00196	.00040	.....	.....
55,000	.00210	.00015	.....	.....		Elastic limit.
56,000	.00285	.00025	Tensile strength.
57,000	.00600	.00865	.....	.....
58,000	.00840	.00240	.....	.....
59,000	.01000	.00160	.....	.....
60,000	.01096	.00096	.....	.....
.....	
.....	

General summary.

Tensile strength per square inch of original section pounds.. 92,600
 Elastic limit per square inch of original section do... 55,000
 Elongation per inch after rupture inch... .145
 Elongation per inch under strain at elastic limit do... .00210
 Reduction in diameter at point of rupture do... .075
 Reduction in area after rupture, per cent of original section 27.4
 Position of rupture ".40 from neck
 Character of broken surface silky, irregular surface
 Elongation of inch sections ".10, ".19*

BODY.

No. 7886.

Marks, ²⁻⁴ M T
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00020	.00020	0.	0.	
10,000	.00050	.00050	.....	.....
20,000	.00095	.00045	.....	.....
30,000	.00140	.00045	.....	.....
35,000	.00150	.00010	.00005	.00005	
40,000	.00165	.00015	.....	.....
42,000	.00175	.00010	0.	0.	
50,000	.00195	.00020	.....	.....
54,000	.00215	.00020	.....	.....		Elastic limit.
55,000	.00225	.00020	.....	.....
56,000	.00250	.00015	.....	.....
57,000	.00450	.00200	.....	.....
58,000	.00825	.00375	.....	.....
59,000	.00950	.00125	.....	.....
91,800	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	91,800
Elastic limit per square inch of original section	do...	54,000
Elongation per inch after rupture	inch	.215
Elongation per inch under strain at elastic limit	do...	.00215
Reduction in diameter at point of rupture	do...	.155
Reduction in area after rupture, per cent of original section		51.9
Position of rupture	"	9 from neck
Character of broken surface		silky
Elongation of inch sections	"	11, " 82*

BODY.

No. 7687.

Marks, ²⁻⁵_{M T}
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 1".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.0001	.0001	0.	0.	
10,000	.0002	.0002	.....	.....
20,000	.0005	.0005	.....	.....
30,000	.0009	.0009	0.	0.	
35,000	.0011	.0011	.....	.....
40,000	.0012	.0012	.....	.....
42,000	.0013	.0013	0.	0.	
50,000	.0018	.0018	.....	.....
51,000	.0019	.0019	.....	.....
52,000	.0028	.0028	Elastic limit.
53,000	.0053	.0053	.....	.....
54,000	.0078	.0078	.....	.....
55,000	.0090	.0090	.....	.....
56,000	.0107	.0107	Tensile strength.
88,500	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section	pounds..	88,500
Elastic limit per square inch of original section	do. . .	51,000
Elongation per inch after rupture	inch. . .	.23
Elongation per inch under strain at elastic limit	do. . .	.0019
Reduction in diameter at point of rupture	do. . .	.155
Reduction in area after rupture, per cent of original section		51.9
Position of rupture	1".05 from neck	
Character of broken surface	silky	
Elongation of inch sections	"14, ".82"	

Body.

No. 7688.

Marks, ²⁻⁶ MT

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.00020	.00020	0.	0.		
10,000	.00045	.00025	.....	.....
20,000	.00086	.00050	.....	.....
30,000	.00145	.00050	.....	.....
35,000	.00160	.00015	0.	0.		
40,000	.00175	.00015	.....	.....
42,000	.00180	.00005	.00005	.00005		
49,000	.00210	.00030		Elastic limit.
50,000	.00250	.00040	.....	.....
51,000	.00280	.00120	.....	.....
52,000	.00290	.00210	.....	.....
58,000	.00800	.00210	Tensile strength.	
54,000	.00940	.00140	.....	.....
87,500	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....pounds.. 87,500
 Elastic limit per square inch of original section.....do... 49,000
 Elongation per inch after rupture.....inch... .24
 Elongation per inch under strain at elastic limit.....do... .00210
 Reduction in diameter at point of rupture.....do... .155
 Reduction in area after rupture, per cent of original section.....do... 51.9
 Position of rupture.....at middle of stem
 Character of broken surface.....silky
 Elongation of inch sections.....".21, ".27"

BODY.

No. 7689.

Marks, ²⁻⁶_{BT}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00005	.00005	0.	0.	
10,000	.00025	.00020	-----	-----	
20,000	.00060	.00035	-----	-----	
30,000	.00100	.00040	-----	-----	
35,000	.00120	.00020	0.	0.	
40,000	.00150	.00030	-----	-----	
42,000	.00155	.00005	0.	0.	
50,000	.00195	.00040	-----	-----	
52,000	.00205	.00010	-----	-----		Elastic limit.
53,000	.00250	.00045	-----	-----	
54,000	.00600	.00350	-----	-----	
55,000	.00900	.00300	-----	-----	
56,000	.01065	.00165	-----	-----	
57,000	.01190	.00125	-----	-----	
88,600	-----	-----	-----	-----	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	88,600
Elastic limit per square inch of original section	do...	52,000
Elongation per inch after rupture	inch...	.24
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture	1".	.85 from neck
Character of broken surface		silky
Elongation of inch sections	" .16, "	.32*

BODY.

No. 7724.

Marks, B M T²⁻¹

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00085	.00025	.....	.....
20,000	.00065	.00080	.....	.....
30,000	.00100	.00085	.....	.....
35,000	.00115	.00015	0.	0.	
40,000	.00135	.00020	.....	.....
42,000	.00145	.00010	0.	0.	
50,000	.00170	.00025	.....	.....
56,000	.00215	.00045	.....	.....		Elastic limit.
57,000	.00235	.00020	.....	.....
58,000	.00260	.00025	.....	.....
59,000	.00835	.00075	.....	.....
60,000	.00410	.00075	.....	.....
61,000	.00580	.00170	Tensile strength.
98,100	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original sectionpounds.. 98,100
 Elastic limit per square inch of original sectiondo... 56,000
 Elongation per inch after ruptureinch... .20
 Elongation per inch under strain at elastic limitdo... .00215
 Reduction in diameter at point of rupturedo... .085
 Reduction in area after rupture, per cent of original section..... .80.7
 Position of rupture..... 1" from neck
 Character of broken surface silky
 Elongation of inch sections ".18, ".22*

BODY.

No. 7725.

Marks, ²⁻³ B M T

Diameter, ".505.

Sectional area, .20 square inch.

Guaged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	.....	.....
20,000	.00065	.00030	.....	.....
30,000	.00100	.00035	.....	.....
35,000	.00115	.00015	0.	0.	
40,000	.00135	.00020	.....	.....
42,000	.00145	.00010	0.	0.	
50,000	.00175	.00030	.....	.....
60,000	.00210	.00035	.....	.....		Elastic limit.
69,000	.00250	.00040	.....	.....
70,000	.00270	.00020	.....	.....
71,000	.00300	.00030	.....	.....
72,000	.00400	.00100	.....	.....
73,000	.00600	.00200	Tensile strength.
74,000	.00960	.00360	.....	.....
102,900	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....	pounds..	102,900
Elastic limit per square inch of original section.....	do...	69,000
Elongation per inch after rupture.....	inch..	.22
Elongation per inch under strain at elastic limit.....	do...	.00250
Reduction in diameter at point of rupture.....	do...	.125
Reduction in area after rupture, per cent of original section.....		43.3
Position of rupture.....	at middle of stem	
Character of broken surface.....	silky	
Elongation of inch sections.....	"16, ".28*	

BREECHBLOCK.

No. 7488.

Marks, ¹⁴ B B

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	Inch.	Inch.	Inch.	Inch.	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00040	.00025	.....	.....
20,000	.00085	.00045	.....	.....
30,000	.00105	.00020	.....	.....
40,000	.00145	.00040	0.	0.	
46,000	.00165	.00020	.00005	.00005	
50,000	.00190	.00025	.....	.....
51,000	.00195	.00005	.....	.....
52,000	.00200	.00005	.....	.....
53,000	.00480	.00280	Elastic limit.
54,000	.00550	.00070	.....	.....
55,000	.00645	.00085	.....	.....
56,000	.00750	.00105	.....	.....
57,000	.00865	.00115	.....	.....
98,000	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	98,000
Elastic limit per square inch of original section	do..	52,000
Elongation per inch after rupture	inch..	.285
Elongation per inch under strain at elastic limit	do..	.00200
Reduction in diameter at point of rupture	do..	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		1".11 from neck
Character of broken surface		silky
Elongation of inch sections		".29", ".18

TABULATION OF TENSION SPECIMENS FROM 75-MILLIMETER MOUNTAIN GUNS.

STEMS 2" LONG, ".505 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	Pounds.	Per ct.	Per ct.		
7486	Body	Middle	51,000	97,550	21.0	37.1	Silky, trace of granulation.	Breech end.
7487	do	Inside	52,000	96,200	19.0	30.7	Granular, 80 per cent; silky lamellar, 20 per cent.	Do.
7489	do	Middle	49,000	90,800	23.0	43.3	Silky.	Do.
7546	do	do	47,000	89,050	18.5	30.7	Granular, 70 per cent; silky, 30 per cent.	Do.
7547	do	do	55,000	99,500	19.5	37.1	Granular, 50 per cent; silky, 50 per cent.	Do.
7530	do	do	58,000	99,100	19.0	37.1	Silky, oblique, trace of granulation.	Do.
7551	do	do	55,000	98,000	25.0	57.2	Fine, silky	Do.
7686	do	Middle	56,000	95,500	20.0	43.3	Silky	Do.
7687	do	do	56,000	95,200	19.0	34.0	do	Do.
7688	do	do	55,000	92,600	14.5	27.4	Silky, irregular surface.	Do.
7696	do	do	54,000	91,800	21.5	51.9	Silky	Muzzle end.
7687	do	do	51,000	88,500	23.0	51.9	do	Do.
7698	do	do	49,000	87,500	24.0	51.9	do	Do.
7699	do	do	52,000	88,600	24.0	46.2	do	Breech end.
7724	do	Middle	56,000	98,100	20.0	30.7	do	Do.
7725	do	do	69,000	102,900	22.0	43.3	do	Do.
7488	Breechblock.	do	52,000	98,000	23.5	43.3	do	.....

75-MILLIMETER MOUNTAIN GUNS—BODIES.

SPECIMENS FROM BREECH ENDS.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
	<i>Inch.</i>	<i>Sq. in.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Per ct.</i>	<i>Per ct.</i>		<i>" "</i>
1*	.505	.20	60,000	102,500	18.5	37.1	Fine silky .....	.28*, .09
2	.499	.196	64,290	106,160	18.0	35.7	Silky, trace of granulation.	.26*, .10
3*	.505	.20	62,000	107,000	19.5	34.0	Silky, in part granular.	.26*, .13
3B	.505	.20	60,500	102,500	20.0	43.3	Fine silky .....	.30*, .10 _g
3C	.505	.20	58,000	95,500	22.0	46.2	do .....	.33*, .11
4	.564	.25	56,800	94,320	19.5	38.4	Silky .....	.10, .29*
5A	.564	.25	60,400	102,080	22.0	38.4	do .....	.30*, .14
5C	.505	.20	61,000	106,500	18.0	37.1	do .....	.09, .27*
1X	.505	.20	63,500	105,400	16.0	34.0	do .....	.24*, .08
2X	.505	.20	59,000	93,900	21.0	43.3	do .....	.19, .23*
4X	.505	.20	57,500	97,000	23.5	49.1	do .....	.13, .34*
5X	.505	.20	59,800	101,000	24.0	46.2	do .....	.33*, .15

SPECIMENS FROM MUZZLE ENDS.

1	.505	.20	57,500	97,100	22.5	37.1	Silky .....	.31*, .14
1A	.505	.20	61,600	100,800	21.5	37.1	do .....	.28*, .15
2	.506	.20	64,800	104,900	19.5	37.1	do .....	.15, .24*
2A	.505	.20	64,500	103,800	22.0	40.3	do .....	.29*, .15
3	.505	.20	53,000	87,500	21.0	40.3	do .....	.32*, .10
3A	.505	.20	50,000	87,900	26.0	37.1	do .....	.27*, .25*
4	.505	.20	52,500	89,000	22.0	43.3	do .....	.12, .32*
4A	.505	.20	52,500	87,000	27.5	46.2	do .....	.38*, .17
5	.505	.20	59,500	94,200	22.5	43.3	do .....	.12, .33*
5A	.505	.20	56,000	93,600	24.0	43.3	do .....	.15, .33*
6	.505	.20	67,500	106,500	19.5	37.1	do .....	.11, .28*
6A	.505	.20	66,000	107,000	18.0	34.0	do .....	.25*, .11
7	.505	.20	62,500	99,500	22.0	40.3	do .....	.30*, .18
7A	.505	.20	62,000	101,500	21.0	40.3	do .....	.13, .29*
8	.505	.20	63,500	104,000	18.5	34.0	do .....	.25*, .12
8A	.505	.20	61,000	102,000	16.5	34.0	do .....	.24*, .07

75-MILLIMETER MOUNTAIN GUNS—BREECHBLOCKS.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 1 inch.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
	<i>Inch.</i>	<i>Sq. in.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Per ct.</i>	<i>Per ct.</i>		<i>" "</i>
1	.505	.20	77,000	124,000	25.0	40.3	Fine silky .....	.25
2	.503	.20	88,000	138,000	23.0	40.3	Fine granular, silky center.	.28
3	.505	.20	89,000	135,500	22.0	34.0	Granular, silky center.	.22
4	.505	.20	88,000	130,500	25.0	40.3	Silky, interspersed with fine granulation.	.25
5	.503	.20	83,000	128,500	23.0	40.3	Silky .....	.28
6	.505	.20	83,500	129,000	22.0	40.3	do .....	.22
9	.505	.20	90,000	137,000	22.0	37.1	Fine granular, silky center.	.22
10	.505	.20	76,000	125,200	24.0	37.1	Granular, silky center.	.24

3-INCH R. F. GUNS.

**SPECIMENS FROM TUBES, JACKETS, BREECHBLOCKS,
HOOPS, AND CARRIER BLOCKS.**

TUBE.

No. 7621.

Marks, ^{31949 E, F, I} B T, M.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	Inch.	Inch.	Inch.	Inch.	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020	.....	.....
20,000	.00075	.00040	.....	.....
30,000	.00105	.00080	.....	.....
35,000	.00120	.00075	0.	0.	
40,000	.00145	.00025	.....	.....
42,000	.00150	.00005	0.	0.	
51,000	.00185	.00085	.....	.....
52,000	.00190	.00005	.....	.....
53,000	.01715	.01525	.....	.....
54,000	.01815	.00100	.....	.....
55,000	.01920	.00105	.....	.....
56,000	.02040	.00120	.....	.....
57,000	.02200	.00160	.....	.....
57,550	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	57,550
Elastic limit per square inch of original section.....	do....	52,000
Elongation per inch after rupture	inch..	.245
Elongation per inch under strain at elastic limit.....	do....	.00190
Reduction in diameter at point of rupture.....	do....	.18
Reduction in area after rupture, per cent of original section.....		46.2
Position of rupture	" .85 from neck	
Character of broken surface.....	silky	
Elongation of inch sections.....	" .34", ".15	

TUBE.

No. 7759.

Marks, ^{37578 P₁₆ F₁}_{M T₂ I}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	0.	0.	
20,000	.00060	.00030	0.	0.	
30,000	.00100	.00040	0.	0.	
40,000	.00140	.00040	0.	0.	
46,000	.00155	.00015	0.	0.	
50,000	.00165	.00010			
55,000	.00185	.00020			
60,000	.00200	.00015			
65,000	.00215	.00015			Elastic limit.
70,000	.00240	.00025			
75,000	.00260	.00020			
76,000	.00295	.00035			
77,000	.00550	.00255			
78,000	.00795	.00245			Tensile strength.
79,000	.00975	.00180			
80,000	.01200	.00225			
110,200					

General summary.

Tensile strength per square inch of original section.....	pounds..	110,200
Elastic limit per square inch of original section.....	do..	76,000
Elongation per inch after rupture.....	Inch..	.16
Elongation per inch under strain at elastic limit.....	do..	.00260
Reduction in diameter at point of rupture.....	do..	.075
Reduction in area after rupture, per cent of original section.....		27.4
Position of rupture.....		".95 from neck
Character of broken surface.....		silky
Elongation of inch sections.....		".28", ".09

TUBE.

No. 7760.

Marks, ^{37646 B}_{B T, M}
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2'.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00045	.00080	.....	.....
20,000	.00070	.00025	.....	.....
30,000	.00105	.00085	.....	.....
40,000	.00140	.00085	0.	0.	Elastic limit.
45,000	.00160	.00020	0.	0.	
60,000	.00205	.00045	.....	.....
65,000	.00250	.00045	.....	.....
70,000	.00280	.00080	.....	.....
71,000	.00285	.00055	Tensile strength.
72,000	.00450	.00115	.....	.....
73,000	.00510	.00160	.....	.....
74,000	.00725	.00115	.....	.....
110,200	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section	pounds..	110,200
Elastic limit per square inch of original section	do...	69,000
Elongation per inch after rupture	inch.	.21
Elongation per inch under strain at elastic limit	do...	.00250
Reduction in diameter at point of rupture	do...	.145
Reduction in area after rupture, per cent of original section		49.1
Position of rupture	" 9 from neck	
Character of broken surface	fine silky, cup shaped	
Elongation of inch sections	" .82", ".10	

JACKET.

No. 7622.

Marks, ^{35285 B₁}
 B T, M
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00085	.00025	.....	.....
20,000	.00070	.00085	.....	.....
30,000	.00105	.00085	.....	.....
40,000	.00145	.00040	0.	0.	Elastic limit.
46,000	.00180	.00015	0.	0.	
59,000	.00205	.00045	.....	.....
60,000	.00450	.00245	.....	.....
61,000	.00700	.00250	.....	.....
62,000	.00850	.00150	Tensile strength.
63,000	.00980	.00080	.....	.....
64,000	.01015	.00085	.....	.....
65,000	.01070	.00066	.....	.....
102,000	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....pounds.. 102,000
 Elastic limit per square inch of original section.....do... 59,000
 Elongation per inch after rupture.....inch... .19
 Elongation per inch under strain at elastic limit.....do... .00205
 Reduction in diameter at point of rupture.....do... .095
 Reduction in area after rupture, per cent of original section.....do... 34
 Position of rupture....." 35 from neck
 Character of broken surface...granular 50 per cent, silky 50 per cent, opened cracks in surface of stem
 Elongation of inch sections....." 13, " 25*

JACKET.

No. 7770.

Marks, ^{26288 B₁}
_{B T₁ M}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00040	.00080	.....	.....
20,000	.00075	.00085	.....	.....
30,000	.00105	.00080	.....	.....
40,000	.00140	.00085	0.	0.	Elastic limit.
46,000	.00160	.00020	0.	0.	
60,000	.00206	.00045	.....	.....
68,000	.00240	.00035	.....	.....
69,000	.00265	.00025	.....	.....
70,000	.00900	.00635	Tensile strength.
71,000	.01000	.00100	.....	.....
72,000	.01075	.00075	.....	.....
78,000	.01190	.00115	.....	.....
100,500	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section..... pounds... 100,500
 Elastic limit per square inch of original section..... do... 68,000
 Elongation per inch after rupture..... inch... .07
 Elongation per inch under strain at elastic limit..... do... .00240
 Reduction in diameter at point of rupture..... do... .025
 Reduction in area after rupture, per cent of original section..... 9.5
 Position of rupture..... at the neck
 Character of broken surface.....dull gray, amorphous 60 per cent, granular 40 per cent;
 opened cracks in surface of stem.
 Elongation of inch sections ".09", ".05

BREECHBLOCK.

No. 7677.

Marks, ^{1958 B, F,}_{T, M}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	0.	0.	
20,000	.00065	.00080	.....	.....
30,000	.00105	.00040	.....	.....
35,000	.00125	.00020	.....	.....
40,000	.00145	.00020	.....	.....
46,000	.00160	.00015	0.	0.	
60,000	.00210	.00050	0.	0.	
65,000	.00235	.00025	.....	.....
70,000	.00255	.00020	Elastic limit.
80,000	.00295	.00040	.....	.....
82,000	.00800	.00005	.....	.....
88,000	.00810	.00010	.....	.....
	.00555	.00245	.....	.....
84,000	.00800	.00245	.....	.....
85,000	.00890	.00090	.....	.....
86,000	.00980	.00070	.....	.....
87,000	.01025	.00065	Tensile strength.
128,900	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section	pounds..	128,900
Elastic limit per square inch of original section	do...	82,000
Elongation per inch after rupture	inch..	.165
Elongation per inch under strain at elastic limit	do...	.00800
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		" .7 from neck
Character of broken surface		silky, cup-shaped
Elongation of inch sections		".08, ".25*

BREECHBLOCK.

No. 7747.

Marks, ^{19056 B, F,}
T, M.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00045	.00035	.....	.....
20,000	.00070	.00025	.....	.....
30,000	.00095	.00025	.....	.....
40,000	.00120	.00025	0.	0.	
46,000	.00145	.00025	0.	0.	
60,000	.00195	.00050	.....	.....
70,000	.00235	.00040	.....	.....
75,000	.00250	.00015	.....	.....
76,000	.00255	.00005	Elastic limit.
77,000	.00345	.00090	.....	.....
78,000	.00395	.00050	.....	.....
79,000	.00540	.00145	.....	.....
80,000	.00630	.00090	Tensile strength.
81,000	.00660	.00080	.....	.....
121,000	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section	pounds..	121,000
Elastic limit per square inch of original section	do....	76,000
Elongation per inch after rupture	inch..	.155
Elongation per inch under strain at elastic limit	do....	.00255
Reduction in diameter at point of rupture	do....	.105
Reduction in area after rupture, per cent of original section .....	.....	37.1
Position of rupture	" .85 from neck	
Character of broken surface	fine silky	
Elongation of inch sections	" .28, ".08	

LOCKING HOOP.

No. 7727.

Marks, ^{85786 B, F₁}
_{B T₁ M.}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00005	.00005	0.	0.	
10,000	.00030	.00025	.....	.....
20,000	.00060	.00030	.....	.....
30,000	.00085	.00035	.....	.....
40,000	.00120	.00035	.....	.....
45,000	.00145	.00015	0.	0.	
50,000	.00170	.00025	0.	0.	
60,000	.00195	.00025	.....	.....
70,000	.00240	.00045	.....	.....
64,000	.00800	.00080	Elastic limit. Load felt.
65,000	.01445	.01145	.....	.....
66,000	.01585	.00090	Tensile strength.
67,000	.01680	.00145	.....	.....
68,000	.01835	.00155	.....	.....
69,000	.02000	.00165	.....	.....
70,000	.02145	.00145	.....	.....

General summary.

Tensile strength per square inch of original section pounds.. 95,000
 Elastic limit per square inch of original section do... 70,000
 Elongation per inch after rupture inch... .25
 Elongation per inch under strain at elastic limit do... .00240
 Reduction in diameter at point of rupture do... .145
 Reduction in area after rupture, per cent of original section 49.1
 Position of rupture at middle of stem
 Character of broken surface silky
 Elongation of inch sections ".22,".28"

LOCKING RING.

No. 7690.

Marks, ^{26118 B, F,}
B T, M

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.00010	.00010	0.	0.		
10,000	.00040	.00080	.....	.....
20,000	.00080	.00040	.....	.....
30,000	.00110	.00080	.....	.....
40,000	.00150	.00040	.....	.....
45,000	.00170	.00020	0.	0.		
50,000	.00190	.00020	0.	0.		
60,000	.00220	.00040		Elastic limit.
65,000	.00255	.00025	.....	.....
66,000	.00800	.00045	.....	.....
67,000	.00490	.00190	.....	.....
68,000	.00590	.00100	.....	.....
69,000	.00745	.00155	.....	.....
70,000	.00850	.00105	Tensile strength.	
106,500	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....pounds.. 106,500
 Elastic limit per square inch of original section.....do... 65,000
 Elongation per inch after rupture.....inch... .21
 Elongation per inch under strain at elastic limit.....do... .00255
 Reduction in diameter at point of rupture.....do... .145
 Reduction in area after rupture, per cent of original section.....do... 49.1
 Position of rupture....." .75 from neck
 Character of broken surface.....silky, cup-shaped ends
 Elongation of inch sections....." .81*, ".11

TABULATION OF TENSION SPECIMENS FROM 3-INCH R. F. GUNS.

STEMS 2" LONG, ".506 DIAMETER

No. of test.	Position in gun.	Location of specimen.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
7621	Tube	Middle	<i>Pounds.</i> 52,000	<i>Pounds.</i> 87,550	<i>Per ct.</i> 24.5	<i>Per ct.</i> 46.2	Silky	Breech end.
7759	.....do	Inside	76,000	110,200	16.0	27.4	.....do	Muzzle end.
7760	.....do	Middle	69,000	110,200	21.0	49.1	Fine silky, cup-shaped.	Breech end.
7622	Jacket .....	.....do	59,000	102,000	19.0	34.0	Granular, 50 per cent; silky, 60 per cent. Opened cracks in surface of stem.	Do.
7770	.....do .....	.....do	68,000	100,500	7.0	9.5	Dull gray, amorphous, 60 per cent; granular, 40 per cent. Opened cracks in surface of stem.	Do.
7677	Breechblock .....	.....do	82,000	123,900	16.5	43.8	Silky, cup-shaped.	
7747	.....do .....	.....do	76,000	121,000	15.5	37.1	Fine silky	
7727	Locking hoop .....	.....do	70,000	95,000	25.0	49.1	Silky	Do.
7690	Locking ring .....	.....do	65,000	105,500	21.0	49.1	Silky, cup-shaped.	Do.

CHEMICAL ANALYSIS.

No. of test.	Description.	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
7747	Breechblock .....	.53	.97	.35	.020	.024

3-INCH R. F. GUNS.

CARRIER BLOCKS.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
1	<i>Inch.</i> .506	<i>Sq. in.</i> .20	<i>Pounds.</i> 63,500	<i>Pounds.</i> 101,000	<i>Per ct.</i> 23.0	<i>Per ct.</i> 54.6	Fine granular, silky center.	" " .32*, .14
2	.505	.20	60,500	96,500	26.5	62.2	.....do .....	.37*, .16
3	.505	.20	61,500	99,000	24.0	57.2	.....do .....	.34*, .14
1	.505	.20	62,500	100,500	23.0	57.2	Fine silky .....	.12, .34*
2	.505	.20	59,500	99,600	24.5	57.2	.....do .....	.35*, .14
1	.505	.20	63,000	107,600	21.0	49.1	.....do .....	.31*, .11
2	.505	.20	67,000	106,000	22.5	54.6	.....do .....	.34*, .10
3	.505	.20	65,500	107,500	20.5	51.9	.....do .....	.33*, .08
4	.506	.20	64,500	109,000	21.0	51.9	.....do .....	.33*, .09

5-INCH R. F. GUNS.

**SPECIMENS FROM TUBES, JACKETS, HOOPS, BREECH-
BLOCK, SPINDLES, AND GAS CHECKS.**



TUBE.

No. 7664.

Marks, ^{33986 B,}
B T, M

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00040	.00080	.....	.....
20,000	.00075	.00085	.....	.....
30,000	.00110	.00085	.....	.....
35,000	.00185	.00025	0.	0.	
40,000	.00150	.00015	.....	.....
42,000	.00155	.00005	0.	0.	
47,000	.00175	.00020	.....	.....
48,000	.00185	.00010	.....	.....
49,000	.00250	.00065	Elastic limit.
50,000	.00775	.00525	.....	.....
51,000	.00900	.00125	.....	.....
52,000	.00965	.00065	.....	.....
53,000	.01050	.00085	Tensile strength.
86,500	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section	pounds..	86,500
Elastic limit per square inch of original section	do..	48,000
Elongation per inch after rupture	inch..	.225
Elongation per inch under strain at elastic limit	do..	.00185
Reduction in diameter at point of rupture	do..	.095
Reduction in area after rupture, per cent of original section		34
Position of rupture	".50 from neck	
Character of broken surface	silky, oblique	
Elongation of inch sections	".36*, ".10	

TUBE.

No. 7678.

Marks, ^{34047 B₁}
_{B T₁ M}
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
Pounds.	Inch.	Inch.	Inch.	Inch.		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.00010	.00010	0.	0.		
10,000	.00085	.00025	.....	.....
20,000	.00065	.00080	.....	.....
30,000	.00100	.00085	.....	.....
35,000	.00115	.00015	0.	0.		
40,000	.00180	.00015	.....	.....
42,000	.00185	.00005	0.	0.		Elastic limit.
50,000	.00155	.00020	.....	.....
51,000	.00185	.00090	.....	.....
52,000	.00400	.00215	.....	.....
53,000	.00585	.00185	.....	.....
54,000	.00660	.00125	.....	.....
55,000	.00840	.00180	.....	.....
88,500	Tensile strength.	

General summary.

Tensile strength per square inch of original section	pounds..	88,500
Elastic limit per square inch of original section	do...	50,000
Elongation per inch after rupture	inch..	.245
Elongation per inch under strain at elastic limit	do...	.00155
Reduction in diameter at point of rupture .....		.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture	1".22 from neck	
Character of broken surface	silky, oblique	
Elongation of inch sections	".20, ".29"	

JACKET.

No. 7619.

Marks, ^{15846 B,}
B T, M

Diameter, ".565.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	Inch.	Inch.	Inch.	Inch.	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000333	.000200			
20,000	.000700	.000367			
30,000	.001067	.000533			
40,000	.001433	.000700	0.	0.	
46,000	.001667	.000867	0.	0.	Elastic limit.
56,000	.001900	.000233			
57,000	.001933	.000300			
58,000	.002067	.000734			
59,000	.002333	.001166			
60,000	.002667	.002334			
61,000	.007433	.000766			Tensile strength.
62,000	.008500	.001067			
100,480					

General summary.

Tensile strength per square inch of original section pounds.. 100,480
Elastic limit per square inch of original section do... 57,000
Elongation per inch after rupture inch... .20
Elongation per inch under strain at elastic limit do... .001933
Reduction in diameter at point of rupture do... .155
Reduction in area after rupture, per cent of original section do... 47.2
Position of rupture 1".25 from neck
Character of broken surface silky
Elongation of inch sections ".21, ".28, ".11

JACKET.

No. 7624.

Marks, ^{34196 B₂}
 B T, M
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.000100	.000100	0.	0.		
10,000	.000333	.000233	.....	.....
20,000	.000667	.000884	.....	.....
30,000	.001033	.000366	.....	.....
40,000	.001400	.000367	0.	0.		
45,000	.001567	.000167	.....	.....
50,000	.001767	.000200	0.	0.		
58,000	.002067	.000300		Elastic limit.
59,000	.002200	.000133	.....	.....
60,000	.012667	.010467	.....	.....
61,000	.013667	.001000	.....	.....
62,000	.014700	.001033	.....	.....
63,000	.015600	.000800	Tensile strength.	
64,000	.016833	.001333	.....	.....
92,480	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....	pounds..	92,480
Elastic limit per square inch of original section.....	do...	58,000
Elongation per inch after rupture.....	inch...	.203
Elongation per inch under strain at elastic limit.....	do...	.002067
Reduction in diameter at point of rupture.....	do...	.164
Reduction in area after rupture, per cent of original section.....		49.7
Position of rupture.....	1".6 from neck	
Character of broken surface.....	silky	
Elongation of inch sections.....	" .14, ".35*, ".12	

A, Hoop.

No. 7625.

Marks, ^{34485 B, F₁}
_{B T₁ M}

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000800	.000200	.....	.....
20,000	.000667	.000867	.....	.....
30,000	.001033	.000866	.....	.....
40,000	.001400	.000867	0.	0.	
45,000	.001567	.000167	.....	.....
50,000	.001767	.000200	0.	0.	
60,000	.002133	.000866	.....	.....
63,000	.002267	.000134	.....	.....		Elastic limit.
64,000	.008867	.006600	.....	.....
65,000	.009633	.000766	.....	.....
66,000	.010533	.000900	.....	.....
67,000	.011833	.000900	Tensile strength.
68,000	.012167	.000884	.....	.....
101,400	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section.....pounds.. 101,400
 Elastic limit per square inch of original section.....do... 63,000
 Elongation per inch after rupture.....inch... .167
 Elongation per inch under strain at elastic limit.....do... .002267
 Reduction in diameter at point of rupture.....do... .154
 Reduction in area after rupture, per cent of original section..... 47.2
 Position of rupture.....".90 from neck
 Character of broken surface.....silky
 Elongation of inch sections.....".09, ".09, ".32"

C₃ HOOP.

No. 7680.

Marks, ^{34451 B₁ F₁}
_{B₁ T₁ M}

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00085	.00025	.....	.....
20,000	.00070	.00085	.....	.....
30,000	.00106	.00085	.....	.....
40,000	.00145	.00040	.....	.....
45,000	.00155	.00010	0.	0.	
50,000	.00170	.00015	0.	0.	
60,000	.00200	.00030	.....	.....
69,000	.00245	.00045	.....	.....		Elastic limit.
70,000	.00260	.00015	Tensile strength.
71,000	.00296	.00035	.....	.....
72,000	.00345	.00050	.....	.....
73,000	.00400	.00055	.....	.....
74,000	.00655	.00155	.....	.....
108,000	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section pounds.. 108,000
 Elastic limit per square inch of original section do... 69,000
 Elongation per inch after rupture inch... .14
 Elongation per inch under strain at elastic limit do... .00245
 Reduction in diameter at point of rupture..... do... .065
 Reduction in area after rupture, per cent of original section..... 23.9
 Position of rupture..... ".65 from neck
 Character of broken surface..... fine silky
 Elongation of inch sections..... ".19", ".09

BREECHBLOCK.

No. 7620.

Marks, ^{14640 B, F,} T, M

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00035	.00020	0.	0.	
20,000	.00070	.00035	0.	0.	
30,000	.00105	.00035	0.	0.	
40,000	.00145	.00040	0.	0.	
46,000	.00160	.00015	0.	0.	
50,000	.00175	.00015			
60,000	.00210	.00035			
68,000	.00240	.00030			
69,000	.00245	.00005			Elastic limit.
70,000	.00410	.00165			
71,000	.01110	.00700			
72,000	.01200	.00090			
78,000	.01300	.00100			Tensile strength.
74,000	.01410	.00110			
75,000	.01515	.00105			
104,500					

General summary.

Tensile strength per square inch of original section.....	pound..	104,500
Elastic limit per square inch of original section.....	do...	69,000
Elongation per inch after rupture.....	inch..	.245
Elongation per inch under strain at elastic limit.....	do...	.00245
Reduction in diameter at point of rupture.....	do...	.135
Reduction in area after rupture, per cent of original section.....		46.2
Position of rupture.....		at the middle
Character of broken surface.....		silky
Elongation of inch sections.....		"24, "25

SPINDLE.

No. 7617.

Marks, ^{14638 B₁ F₁}_L
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	Inch.	Inch.	Inch.	Inch.	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00040	.00025	0.	0.	
20,000	.00070	.00030			
30,000	.00110	.00040			
35,000	.00130	.00020			
40,000	.00145	.00015	0.	0.	
46,000	.00165	.00020	0.	0.	
50,000	.00180	.00015			
60,000	.00210	.00030			
70,000	.00250	.00040			
80,000	.00285	.00035			
81,000	.00295	.00010			
82,000	.00300	.00005			
83,000	.00300	0.				Elastic limit.
84,000	.00340	.00040			
85,000	.00400	.00060			
86,000	.00560	.00160			
87,000	.00775	.00215			
88,000	.01000	.00225			Tensile strength.
89,000	.01300	.00300			
111,750					

General summary.

Tensile strength per square inch of original section.....	pounds..	111,750
Elastic limit per square inch of original section.....	do...	83,000
Elongation per inch after rupture.....	inch..	.24
Elongation per inch under strain at elastic limit.....	do...	.00300
Reduction in diameter at point of rupture.....	do...	.195
Reduction in area after rupture, per cent of original section.....		62.2
Position of rupture.....	"	.70 from neck
Character of broken surface.....	fine silky, serrated	
Elongation of inch sections.....	"	.10, ".38*

TABULATION OF TENSION SPECIMENS FROM 5-INCH R. F. GUNS.

STEMS 2" LONG, ".506 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
7664	Tube	Middle	<i>Pounds.</i> 48,000	<i>Pounds.</i> 86,500	<i>Per ct.</i> 22.5	<i>Per ct.</i> 34.0	Silky, oblique....	Breech end.
7678	.....do.....	.....do..	50,000	88,500	24.5	40.3	.....do.....	Do.

STEMS 3" LONG, ".564 DIAMETER.

7619	Jacket	Middle	57,000	100,480	20.0	47.2	Silky.....	Breech end.
7624	.....do.....	.....do..	58,000	92,480	20.3	49.7	.....do.....	Do.
7625	A ₂ hoop.....	.....do..	63,000	101,400	16.7	47.2	.....do.....	Do.

STEMS 2" LONG, ".506 DIAMETER.

7680	C ₂ hoop.....	Middle	69,000	108,000	14.0	23.9	Fine silky.....	Breech end.
7620	Breechblock.....	.....do..	69,000	104,500	24.5	46.2	Silky.....	
7617	Spindle.....	.....do..	83,000	111,750	24.0	62.2	Fine silky, serrated.	

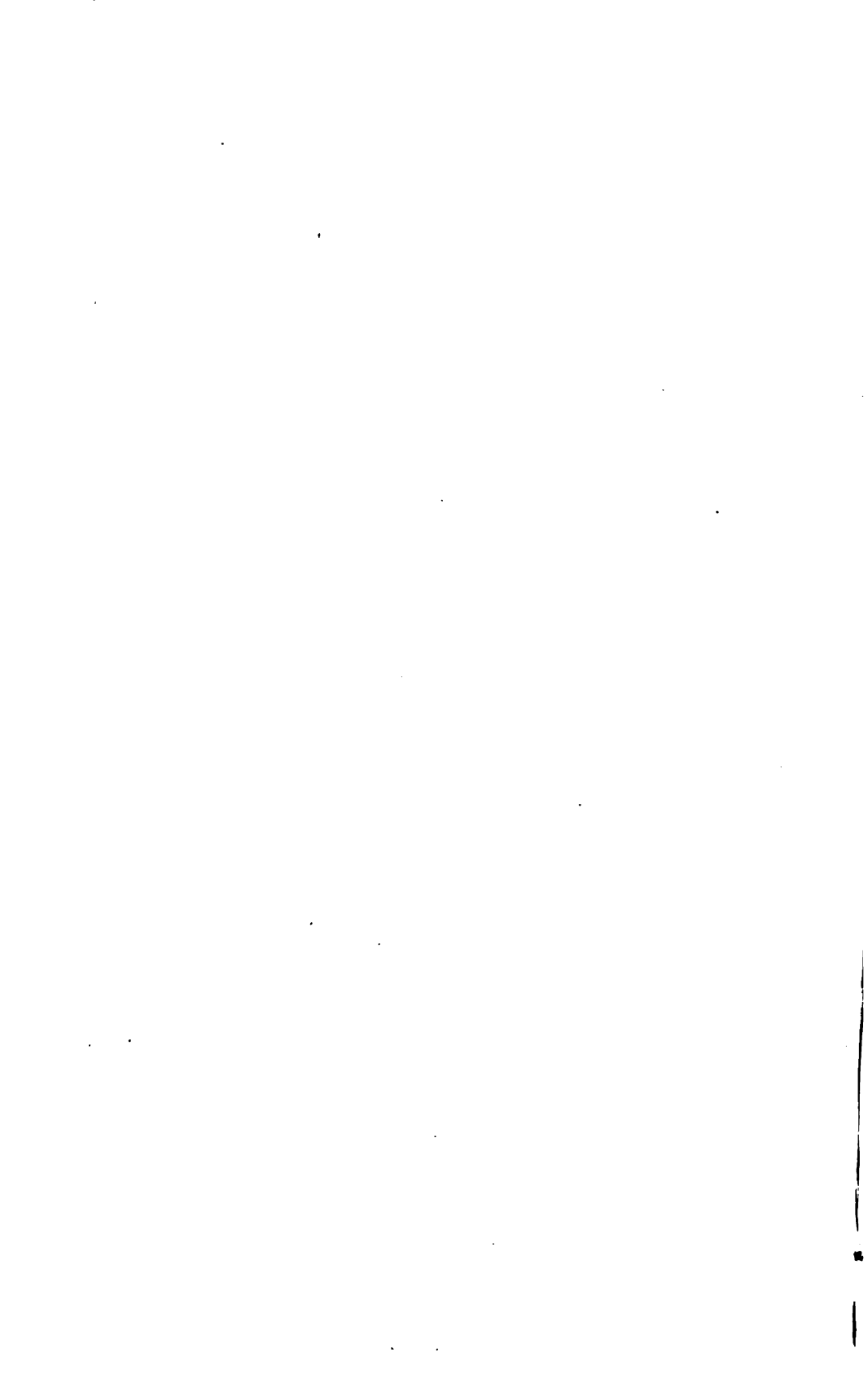
GAS CHECKS.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
1	<i>Inch.</i> .506	<i>Sq. in.</i> .20	<i>Pounds.</i> 76,000	<i>Pounds.</i> 120,100	<i>Per ct.</i> 15.0	<i>Per ct.</i> 40.3	Fine granular, silky center.	".23, ".07
5	.506	.20	74,500	119,100	16.5	37.1	.....do.....	".24, ".07



10-INCH STEEL B. L. RIFLE.

**SPECIMENS FROM TUBE, JACKET, HOOP, SPINDLE,
AND GAS CHECKS.**



TUBE.

No. 7626.

Marks, ^{83966 B,}
 B T, M.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000333	.000233			
20,000	.000667	.000334			
30,000	.001033	.000366			
40,000	.001367	.000334	0.	0.	Elastic limit.
45,000	.001533	.000166			
50,000	.001700	.000167	0.	0.	
54,000	.001767	.000067			
55,000	.001933	.000166			
56,000	.007333	.006400			
57,000	.008167	.000834			
58,000	.008967	.000800			
59,000	.009333	.000966			
93,560					

General summary.

Tensile strength per square inch of original section	pounds..	93,560
Elastic limit per square inch of original section	do...	54,000
Elongation per inch after rupture	inch...	.197
Elongation per inch under strain at elastic limit	do...	.001767
Reduction in diameter at point of rupture	do...	.144
Reduction in area after rupture, per cent of original section		44.6
Position of rupture	1".19 from neck	
Character of broken surface	silky	
Elongation of inch sections	" .26", ".22", ".11	

JACKET.

No. 7676.

Marks, ^{34088 B₁}
_{B T₆ M}

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3'.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	0.	0.	Initial load.	
5,000	.000200	.000200	0.	0.		
10,000	.000367	.000167	.....	.....
20,000	.000767	.000400	.....	.....
30,000	.001200	.000433	.....	.....
35,000	.001333	.000133	0.	0.		
40,000	.001500	.000167	.....	.....
42,000	.001600	.000100	0.	0.		
50,000	.001867	.000267		Elastic limit.
51,000	.002067	.000200	.....	.....
52,000	.002333	.000266	.....	.....
53,000	.003167	.000834	.....	.....
54,000	.004667	.001500	Tensile strength.	
55,000	.005500	.000833	.....	.....
97,040	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section	pounds..	97,040
Elastic limit per square inch of original section	do...	50,000
Elongation per inch after rupture	inch...	.193
Elongation per inch under strain at elastic limit	do...	.001867
Reduction in diameter at point of rupture	do...	.144
Reduction in area after rupture, per cent of original section		44.6
Position of rupture	1" 4 from neck	
Character of broken surface	silky	
Elongation of inch sections	" .10, " .32, " .16	

C₂ HOOP.

No. 7623.

Marks, ^{29802 B,}
B T, M

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	Inch.	Inch.	Inch.	Inch.	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000833	.000200	.....	.....
20,000	.000700	.000367	.....	.....
30,000	.001633	.000833	.....	.....
40,000	.001400	.000867	.....	.....
45,000	.001567	.000167	0.	0.	
50,000	.001733	.000166	0.	0.	
60,000	.002067	.000834	.....	.....
62,000	.002133	.000066	.....	.....		Elastic limit.
63,000	.002233	.000100	.....	.....
64,000	.008333	.906600	.....	.....
65,000	.003800	.000467	.....	.....
66,000	.009767	.000467	.....	.....
67,000	.010600	.000633	Tensile strength.
103,120	.....	.....	.....	.....

General summary.

Tensile strength per square inch of original section..... pounds.. 103,120
 Elastic limit per square inch of original section..... do... 62,000
 Elongation per inch after rupture..... inch... .207
 Elongation per inch under strain at elastic limit..... do... .002133
 Reduction in diameter at point of rupture..... do... .144
 Reduction in area after rupture, per cent of original section..... do... 44.6
 Position of rupture..... at middle of stem
 Character of broken surface..... silky, oblique
 Elongation of inch sections..... " 14, " 34, " 14

SPINDLE.

No. 7616.

Marks, 14209 B, F₃
T₁ M

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	Inch.	Inch.	Inch.	Inch.	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000167	.000167	0.	0.	
10,000	.000367	.000200	-----	-----	
20,000	.000767	.000400	-----	-----	
30,000	.001167	.000400	-----	-----	
40,000	.001533	.000366	0.	0.	
46,000	.001733	.000200	0.	0.	
50,000	.001900	.000167	-----	-----	
60,000	.002267	.000367	-----	-----	
70,000	.002667	.000400	0.	0.		Elastic limit.
71,000	.002700	.000033	-----	-----	
72,000	.002767	.000067	-----	-----	
73,000	.003333	.002566	-----	-----	
74,000	.003667	.004364	-----	-----	
75,000	.010333	.006666	-----	-----	
76,000	.011000	.006667	-----	-----	
77,000	.011667	.006667	-----	-----	
78,000	.012500	.006833	-----	-----	
113,600	-----	-----	-----	-----	Tensile strength.

General summary.

Tensile strength per square inch of original section.....	pounds..	117,600
Elastic limit per square inch of original section.....	do...	72,000
Elongation per inch after rupture.....	inch...	.153
Elongation per inch under strain at elastic limit.....	do...	.002767
Reduction in diameter at point of rupture.....	do...	.124
Reduction in area after rupture, per cent of original section.....	do...	39.2
Position of rupture.....		1".45 from neck
Character of broken surface.....		silky
Elongation of inch sections.....	"11, ".26*, ".09	

TABULATION OF TENSION SPECIMENS FROM 10-INCH STEEL B. L. RIFLE.

STEMS 3" LONG, ".564 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	Pounds.	Per ct.	Per ct.		
7625	Tube.....	Middle.....	51,000	93,560	19.7	44.6	Silky.....	Breech end.
7676	Jacket.....	do.....	50,000	97,040	19.3	44.6	do.....	Do.
7623	Hoop.....	do.....	62,000	103,120	20.7	44.6	Silky, oblique...	Do.
7616	Spindle.....	do.....	72,000	113,600	15.3	39.2	Silky.....	

10-INCH STEEL B. L. RIFLES.

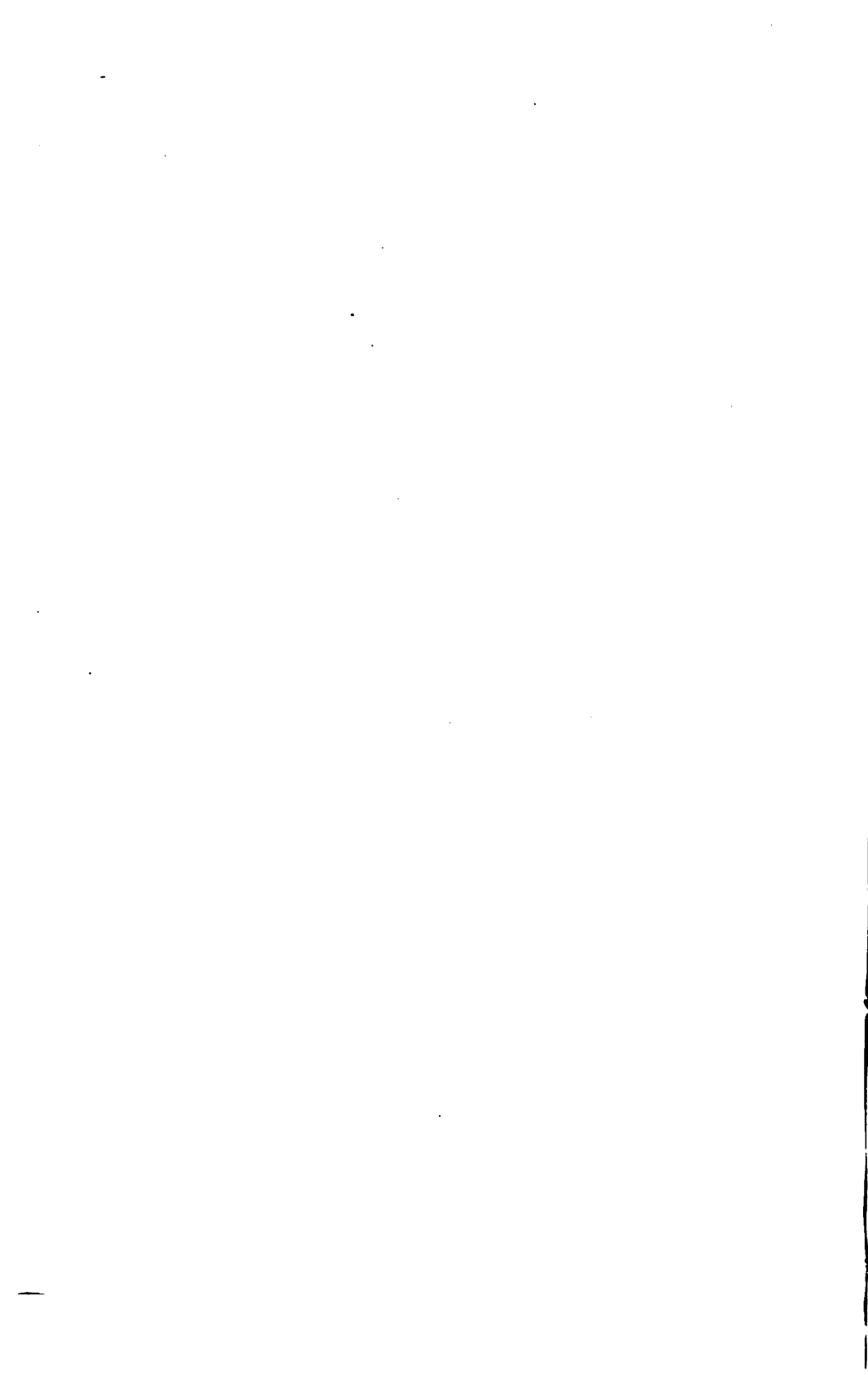
GAS CHECKS.

Marks.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
	Inch.	Sq. in.	Pounds.	Pounds.	Per ct.	Per ct.		"
2	.565	.20	76,500	126,600	24.0	37.1	Fine granular, silky center.....	.24
4	.565	.20	81,000	133,500	13.0	34.0	do.....	.13
5	.565	.20	92,000	146,500	24.0	37.1	do.....	.24
8	.565	.20	79,000	123,100	14.0	37.1	do.....	.14
9	.565	.20	77,500	133,050	27.0	37.1	do.....	.27

12-INCH STEEL B. L. MORTARS.

SPECIMENS FROM GAS CHECKS.

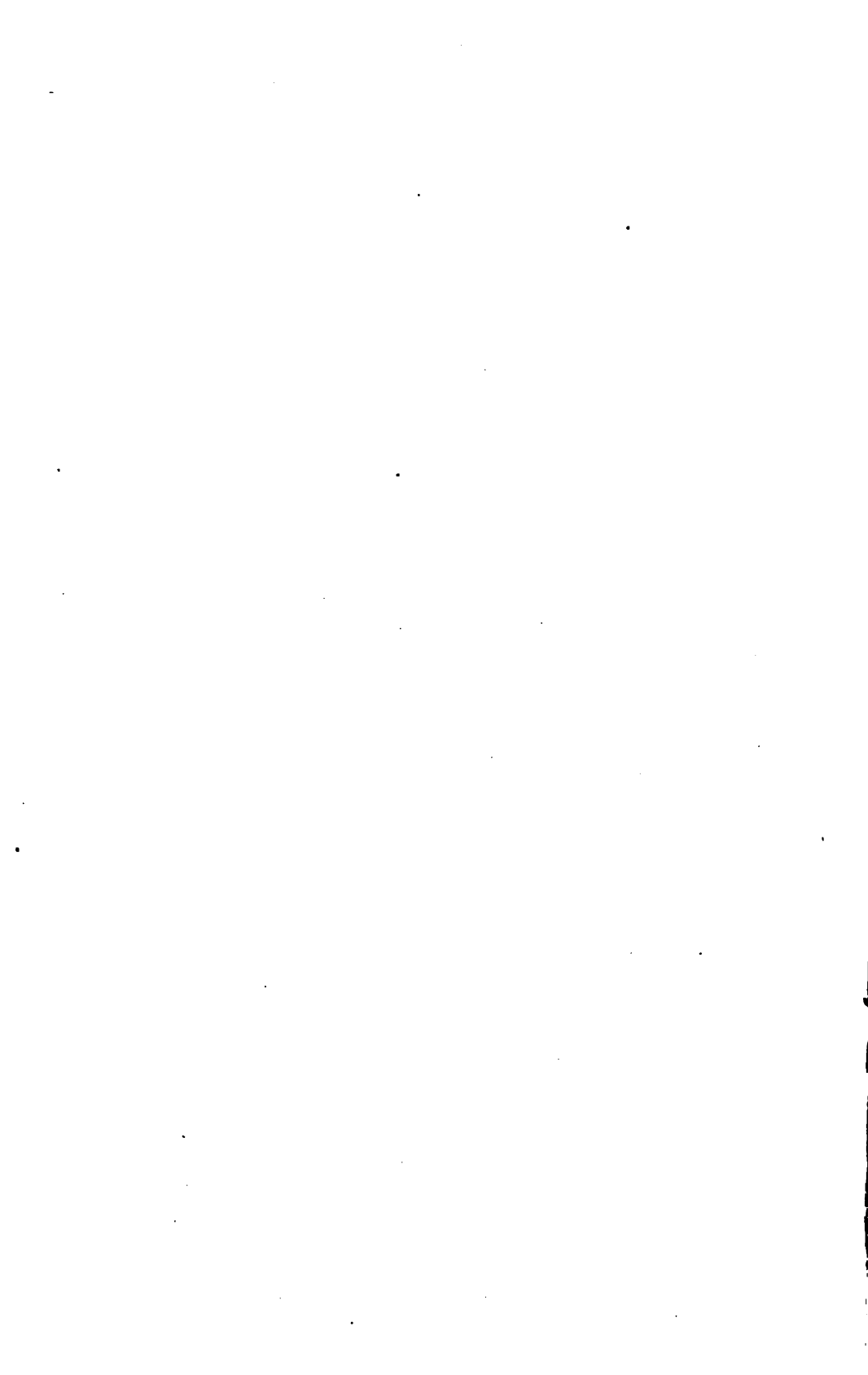




HYDROSTATIC TEST OF GUN HOOP.

SUPPLEMENTARY TEST OF STREAKED HOOP

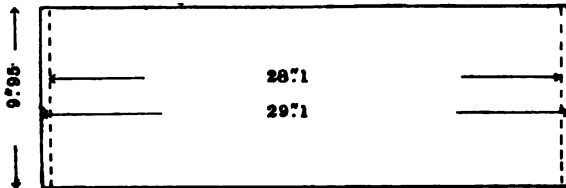
No. 17093 B3.



HYDROSTATIC TEST OF A SECTION OF STREAKED HOOP No. 17093 B₁.

A section 9".95 long, 28".1 interior diameter, ".50 thickness of walls, without flanged ends, was subjected to interior hydrostatic pressure. For the earlier test of flanged section of this hoop see Report 1902, p. 110.

DETAILS OF TESTS.



Expansion of the hoop measured at the middle of its length on one diameter.

Fiber stress computed by the formula: $\theta = P \frac{4R^2 + 2R^2}{3(R^2 - R^2)}$

Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	
178	5,000	0.	Initial load.
2,073	60,000	.....	Elastic limit.
2,142	62,000	.....
173	5,000	.117	
2,211	64,000	.....
173	5,000	.169	
2,280	66,000	.....
173	5,000	.215	
2,349	68,000	.....
173	5,000	.244	
2,419	70,000	.....
173	5,000	.276	
2,488	72,000	.....
173	5,000	.313	
2,557	74,000	.....
173	5,000	.346	
2,626	76,000	.....
173	5,000	.396	
2,695	78,000	.....
173	5,000	.432	
2,764	80,000	.....
173	5,000	.481	
2,833	82,000	.....
173	5,000	.529	
2,902	84,000	.....
173	5,000	.591	
2,971	86,000	.....
173	5,000	.692	
3,040	88,000	.....
173	5,000	.760	
3,110	90,000	.....
173	6,000	.85	
First set of hydraulic packings exhausted. Hoop removed from testing fixture.			
Interior diameters at ends: 28".70 to 28".86.			
Circumference at middle of length, exterior: 94".125.			
Packings renewed and test resumed.			
3,179	92,000	.....
173	5,000	.....	Circumference: 94".44.
3,248	94,000	.....
173	5,000	.....	Circumference: 94".88.
3,307	95,716	.....	Ultimate strength.

Hoop ruptured longitudinally, along the line of the principal seam in the surface of the bore, which seam was photographed after the application of 90,000 pounds per square inch fiber stress.

Measurement of circumference at exterior of hoop at middle of length after fracture: 95".16. Circumferential elongation=3".74=4.1 per cent.

Dimensions at fracture: 9".75 length by ".515 thickness.

Appearance of fractured surface, granular, radiating from two points at the surface of the bore 1".4 and 1".6, respectively, from the ends of the hoop, and contained a seamy line 6" long.

Cracks opened during the test in a group of streaks in the vicinity of the place of fracture measured as follows, taken longitudinally:

Cracks on the outside cylindrical surface:

< ".90 >	< ".80 >	< ".40 >
< 1".40 >	< 1".45 >	
< ".65 >		
< ".30 >		

Crack on the inside cylindrical surface:

".20

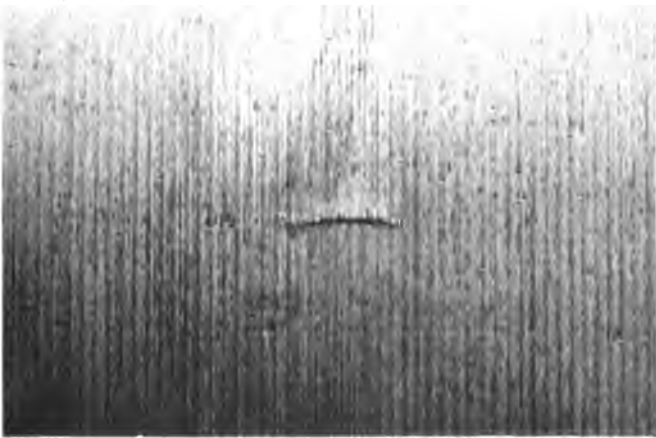
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The streaks of which these cracks formed parts were generally increased in prominence during the test, and some which were at first obscure were now plainly visible. The streaks at and in the line of fracture were among the less conspicuous ones at the commencement of the test.

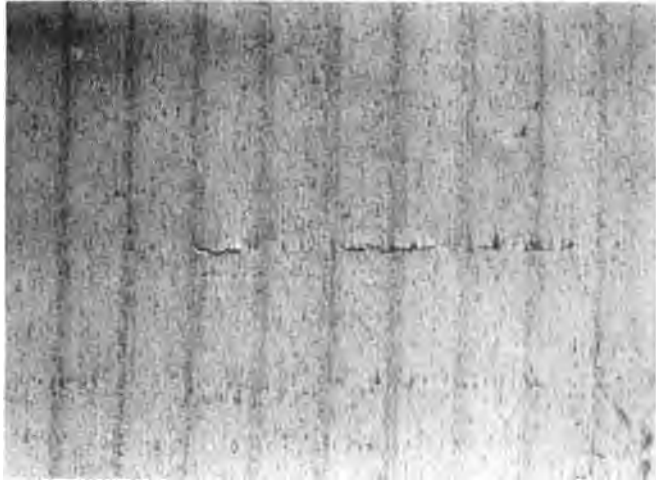
The walls of the hoop were slightly bulged, the diameter at the middle of the length being about ".14 larger than at the ends.

The hoop as received at Watertown Arsenal had an average thickness of 2".57. In the lathe five rings were cut from the outside part, the rings measuring approximately 1".5 by 1".75 in cross section. Upon the removal of this outside metal the hoop sprung out of its cylindrical shape. As finally finished the minimum thickness of the walls was 0".5, the greatest thickness, locally, being 0".55.

Fracture took place where the walls were originally above the minimum thickness, after the test the average thickness here being 0".515.



OUTSIDE CRACK.



INSIDE CRACK.

PHOTOGRAPHS OF CRACKS ON THE SURFACES OF THE HOOP AFTER A TANGENTIAL LOAD OF 90,000 LBS. PER SQ. IN. ON THE METAL. NATURAL SIZE.



Tensile tests of rings taken from the outside of streaked hoop No. 17093 B, supplementary section 9" .95 long: Rings cut from outside part of walls when hoop was turned down in the lathe for hydrostatic test. Ring 1 heated and straightened in the arsenal smith shop.

No. of Ring.	Dimensions.		Sectional area.	Elastic limit.		Tensile strength.		Elongation in 70 inches.	Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of 5-inch sections.
	Width.	Thick-ness.		Total.	Per square inch.	Total.	Per square inch.					
1	Inches. 1.755	1.322	Sq. in. 2.67	Pounds. 168,000	Pounds. 62,920	Pounds. 303,600	Pounds. 113,710	Inches. 3.05 Per cent. 4.4	In. Sq. in. 1.70 x 1.48 = 2.52	Per cent. 5.5	Medium granular	" 28, " 21, " 23, " 20, " 30, " 21, " 25, " 25*, " 30, " 23, " 20, " 19, " 19, " 21.
<p>The elastic limit was not sharply defined. One piece from ring No. 1 was retested as follows: 308,000 115,360 Ultimate strength computed on original sectional area. Ring 2 was straightened cold in the arsenal smith shop.</p>												
2	1.715	1.486	2.55	162,000	68,580	255,400	100,160	In. 3.35 In. 60 inches. 8.4	1.58 x 1.40 = 2.21	18.3	Granular, radiating from a silky spot at an inside corner of the ring. Openings exists in four places on the inside surface of the ring.	" 24, " 41, " 63, " 73*, " 51, " 36, " 28, " 20.
<p>Rings 3, 4, and 5 cut apart: sections taken for tangential tests of the metal. The remaining parts of the rings were straightened cold and tested as follows:</p>												
3	1.740	1.580	2.66	192,000	72,180	266,400	100,150	4.08 In. 60 inches. 8.1	1.57 x 1.38 = 2.17	18.4	Granular, radiating from a dull, amorphous spot at the corner of the bar. In each case fracture began at one of the corners which was on the inside of the ring before straightening.	" 43, " 36, " 27, " 23 " 23, " 23, " 27, " 42, " 63, " 92*
4	1.731	1.365	2.36	162,000	68,640	235,200	99,660	4.05 In. 60 inches. 8.1	1.56 x 1.26 = 1.97	16.5		
5	1.752	1.460	2.56	164,000	64,060	253,700	99,100	4.00 In. 60 inches. 8.0	1.58 x 1.38 = 2.18	14.8		

Tangential tensile specimens taken from rings cut from outside part of walls of supplementary streaked hoop, No. 17093 B₂:

No. 7606.

Marks, From ring 3.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	Elastic limit.
20,000	.0021	.....
30,000	.0031	.....
40,000	.0041	0.	
50,000	.0062	0.	
55,000	.0069	.....
56,000	.0262	.....
57,000	.0272	.....
58,000	.0280	.....
59,000	.0310	.....
60,000	.0330	.0252	
62,000	.0367	.....
64,000	.0408	.....
68,000	.0500	.....
72,000	.0600	.....
76,000	.070	.....
80,000	.082	.....
84,000	.10	.....
88,000	.12	.....
92,000	.14	.....
96,000	.17	.....
100,000	.22	.....
104,000	.32	.....
104,800	.40	Tensile strength. = 14.3 per cent.
0	.43	.....

Elongation of inch sections ".12, ".15, ".16*.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Fractured, ".65 from the neck. Appearance, fine granular, radiating from a dull spot ".10 by ".18 at the circumference.

No. 7607.

Marks, From ring 4.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0009	.....	
20,000	.0020	.....	
30,000	.0080	.....	
40,000	.0041	0.		
50,000	.0051	0.		
55,000	.0057	.....	
56,000	.0059	.....	
57,000	.0060		Elastic limit. Load fell.
51,000	.0141	.....	
52,000	.0180	.....	
53,000	.0273	.....	
54,000	.0306	.....	
55,000	.0321	.....	
56,000	.0340	.....	
58,000	.0387	.....	
60,000	.0434	.....	
64,000	.05	.....	
68,000	.06	.....	
72,000	.07	.....	
76,000	.09	.....	
80,000	.10	.....	
84,000	.12	.....	
88,000	.14	.....	
92,000	.18	.....	
96,000	.24	.....	
100,000	.36	Tensile strength. = 22.7 per cent.	
100,720	.45	.....	
0	.68	.....	

Elongation of inch sections, ".12, ".22, ".34*.
 Diameter at fracture, ".42; area, .1385 square inch.
 Contraction of area, 44.6 per cent.
 Fractured ".95 from the neck. Appearance, fine silky.

No. 7608.

Marks, From ring 5.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	-----	
20,000	.0020	-----	
30,000	.0031	-----	
40,000	.0041	0.	
50,000	.0051	0.	
54,000	.0057	-----	
55,000	.0059	-----	Elastic limit. Load fell.
49,000	.0112	-----	
50,000	.0147	-----	
51,000	.0203	-----	
52,000	.0290	-----	
54,000	.0325	-----	
56,000	.0364	-----	
58,000	.0414	-----	
60,000	.0453	-----	
64,000	.0545	-----	
68,000	.0669	-----	
72,000	.08	-----	
76,000	.10	-----	
80,000	.11	-----	
84,000	.13	-----	
88,000	.16	-----	
92,000	.20	-----	
96,000	.26	-----	
99,840	.52	-----	Tensile strength.
0	.69	-----	=23 per cent.

Elongation of inch sections, ".15, ".36*, ".18.

Diameter at fracture, ".41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Fractured 1".53 from the neck. Appearance, fine silky.

OIL TEMPERED AND ANNEALED HOOP, UNFORGED, FROM INGOT
BLOCK 21859 B₁.

TANGENTIAL TENSILE SPECIMENS.

No. 7768.

Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	-----	
15,000	.0015	-----	
20,000	.0020	0.	
25,000	.0026	-----	
30,000	.0031	0.	
35,000	.0037	0.	
40,000	.0042	0.	
45,000	.0048	0.	
50,000	.0054	.0001	Elastic limit.
51,000	.0058	-----	
52,000	.0090	-----	
53,000	.0127	-----	
54,000	.0142	-----	
55,000	.0170	-----	
56,000	.0183	.0115	
57,000	.0200	-----	
58,000	.0214	-----	
59,000	.0235	-----	
60,000	.0250	.0200	
62,000	.0278	-----	
64,000	.0312	-----	
66,000	.0350	-----	
68,000	.0390	-----	
70,000	.0435	-----	
80,000	.0486	-----	
80,000	.0492	.0812	
90,000	.12	-----	
100,000	.19	-----	
104,400	-----	-----	Tensile strength. = 9.3 per cent.
0	.28	-----	

Elongation of inch sections, ".08, ".09, ".11*.
Diameter at fracture, ".53; area, .2206 square inch.
Contraction of area, 11.8 per cent.
Appearance of fracture, medium fine granular.

No. 7769.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
20,000	.0021	0.	
30,000	.0030	0.	
40,000	.0042	.0001	Elastic limit.
45,000	.0048	.0002	
50,000	.0054	.0002	
51,000	.0063		
52,000	.0138		
53,000	.0152		
54,000	.0175		
55,000	.0192	.0122	
56,000	.0210		
57,000	.0221		
58,000	.0241		
59,000	.0260		
60,000	.0286	.0206	
70,000	.0485	.0390	
80,000	.0750	.0635	
90,000	.12		
100,000	.20		
102,560			Tensile strength.
0	.22		=7.3 per cent.

Elongation of inch sections, ".07, ".07, ".08*.

Diameter at fracture, ".54; area, .2290 square inch.

Contraction of area, 8.4 per cent.

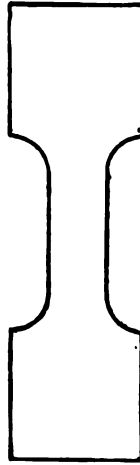
Appearance of fracture, medium fine granular.

CHEMICAL ANALYSIS.

No. of test specimen.	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
7768	.61	.85	.24	.017	.024

15-POUNDER CASEMATE MOUNTS.

SPECIMENS FROM SHIELDS.



No. of test.	Mark on speci-men.	Dimensions.		Sec-tional area.	Elastic limit.		Tensile strength.		Elongation.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
		Width.	Thick-ness.		Total.	Per square inch.	Total.	Per square inch.	Inch.	Per cent.				
10660	1	.566 diam	.20	Pounds.	Pounds.	Pounds.	Pounds.	Inch.	Per cent.	Sq. in.	Per cent.	Fine silky. do. do. do. Fracture began at a point at circumference .12 deep.	" 30", " 10, " 20", " 21", " 27", " 20, " 10, " 10", " 08	
	2	.566 diam	.20	11,500	17,400	87,000	.49	24.5	.80 diam. = .0707..	64.6				
	1A	.566 diam	.20	10,700	16,600	85,000	.41	20.5	.82 diam. = .0804..	59.8				
	2A	.566 diam	.20	12,700	16,900	84,500	.67	22.3	.78 diam. = .0616..	57.2				
10661	1	.875	.578	.50	47,800	90,600	.52	26.0	.65 x .42 = .273.....	45.4	Silky.....	" 48", " 06,		
	2	.875	.578	.50	44,700	85,400	.11	6.5	.85 x .56 = .476.....	4.8	Granular.....	" 04, " 07",		

PISTON RODS AND RETRACTION ROPES.

PISTON RODS AND RETRACTION ROPES.

PISTON RODS.

PROOF STRESSES APPLIED TO PISTON RODS FOR GUN CARRIAGES.

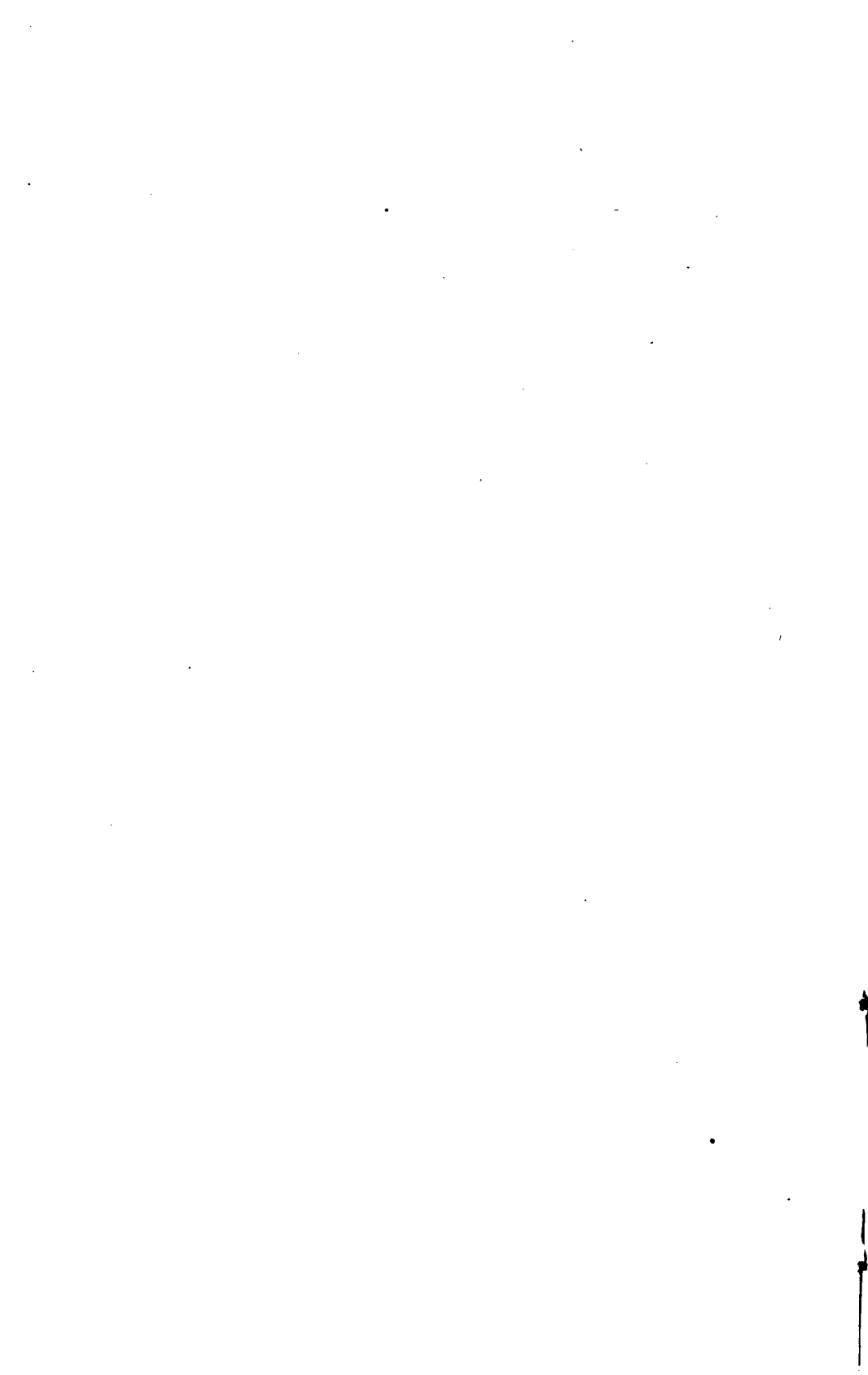
Description.	Tensile stress applied.
75-millimeter Vicker-Maxim mountain gun carriages	<i>Pounds.</i> 12, 500
15-pounder Driggs-Seabury R. F. gun carriages	131, 966

WIRE RETRACTION ROPES.

PROOF STRESSES APPLIED TO WIRE RETRACTION ROPES FOR GUN CARRIAGES.

Description.	Tensile stress applied.
1-inch steel wire retraction ropes with conical sockets, for 8-inch disappearing carriages	<i>Pounds.</i> 7, 080
1-inch steel wire retraction ropes with conical sockets, for 10-inch disappearing carriages	8, 800
1-inch steel wire retraction ropes with conical sockets, for 12-inch disappearing carriages	15, 000

HELICAL SPRINGS.



COUNTER RECOIL SPRINGS FOR 6-INCH BARBETTE GUN CARRIAGES,
MODEL 1900.

Specifications require:

DIMENSIONS.

Outer spring, exterior diameter.....	inches..	7.65±.06
Outer spring, interior diameter.....	do....	5.16±.12
Inner spring, exterior diameter.....	do....	4.28±.06
Inner spring, interior diameter.....	do....	2.28±.12

SUSTAINING POWER.

Outer spring to sustain at least 5,000 pounds at height of.....	inches..	23.125
Inner spring to sustain at least 5,000 pounds at height of.....	do....	19.875
Solid heights not greater than.....	do....	16.76
Total height of 4 springs (2 outer and 2 inner) under 11,000 pounds, not less than.....	do....	70
Neither inner spring showing less height than.....	do....	17.05
Nor outer spring less than.....	do....	17.50

Close down 60 hours, and also load 100 times, and meet above requirements.

COMPRESSION TESTS.

DESCRIPTION OF.

Tests were made upon 8 springs, 4 outer and 4 inner.

The original resistance of the several springs was determined at the prescribed heights and load, then closed down and resistance determined on the return movement.

Free heights were measured and springs again loaded to prescribed heights and load.

Set No. 1 compressed 100 times, then reloaded. They were next closed down and held closed for a period of 50 hours, then released. Free heights were measured, and again loaded to prescribed heights and load, finally loading each spring with 11,000 pounds.

RESULTS OF TESTS.

REMARKS ON.

1. The initial loading showed a state of resistance in excess of the specifications in the outer springs and in one of the inner coils, three of the latter being found deficient in sustaining power.

2. After closing down none of the springs retained the prescribed sustaining power. The deficiency was greater on the return movement following the state of being closed than upon reloading after release from an intermediate free state. The subsequent repeated loadings of outer and inner springs No. 1 resulted in a further loss in sustaining power, which was increased by closing down the period of 50 hours.

3. Under a load of 11,000 pounds, applied subsequent to the other tests enumerated, none of the outer springs maintained the prescribed minimum height of 17".50 nor none of the inner springs the height of 17".05.

4. Each spring was capable of being closed down to the prescribed height of 16".75. The practical limit, when a number of coils were brought together, was, however, reached before this with seven of the springs.

HELICAL SPRINGS.

DIMENSIONS OF SPRINGS BEFORE TESTING.

OUTER SPRINGS.

	1.	2.	3.	4.
Free height	28.30	28.43	28.33	28.34
Exterior diameter.....	7.61	7.59	7.67	7.61
Diameter of wire.....	1.25	1.25	1.25	1.25
Distance between coils.....	.95	.95	.95	.93
Weight.....	93	92	92½	91½

INNER SPRINGS.

Free height	21.40	21.41	21.41	21.50
Exterior diameter.....	4.20	4.27	4.28	4.30
Diameter of wire.....	1.00	1.00	1.00	1.00
Distance between coils.....	.28	.28	.28	.28
Weight.....	37½	36½	37	37½

DETAILS OF TESTS.

OUTER SPRINGS.

	Number of spring.			
	1.	2.	3.	4.
Free height	28.30	28.43	28.33	28.34
Load at height of 23".125.....	5,290	5,120	5,110	5,080
Height under load of 5,000 pounds.....	23.41	23.24	23.21	23.17
Solid height (practical limit).....	16.82	17.03	16.95	16.80
Load at solid height (practical limit).....	11,800	10,900	10,900	11,000
Load at height of 16".75.....	13,020	14,600	12,960	11,500
Height under load of 5,000 pounds.....	22.10	21.83	21.84	21.83
Load at height of 23".125.....	4,000	3,720	3,760	3,780
Free height	27.88	27.63	27.57	27.75
Load at height of 23".125.....	4,830	4,460	4,490	4,520
Height at load of 5,000 pounds.....	22.97	22.60	22.60	22.63

INNER SPRINGS.

Free height	21.40	21.41	21.41	21.50
Load at height of 19".375.....	4,400	4,640	4,680	5,120
Height under load of 5,000 pounds.....	19.08	19.22	19.25	19.40
Solid height (practical limit).....	17.06	16.65	16.83	16.73
Load at solid height (practical limit).....	9,300	12,500	10,800	13,100
Load at height of 16".75.....	12,900	10,600	12,050	12,100
Height under load of 5,000 pounds.....	18.60	18.50	18.60	18.86
Load at height of 19".375.....	3,280	3,120	3,300	3,800
Free height	21.10	21.07	21.15	21.30
Load at height of 19".375.....	4,200	3,860	4,160	4,730
Height at load of 5,000 pounds.....	19.01	18.89	19.00	19.26

REPEATED LOADING.

Outer spring No. 1: Loaded 100 times from an initial height of 23".125, closing to a height of 17".625, a movement of 5".5.

Inner spring No. 1: Loaded 100 times from an initial height of 19".375, closing to a height of 17".125, a movement of 2".25.

RETEST OF SPRINGS AFTER REPEATED LOADING.

Outer spring No. 1:	
Free height	inches.. 27.59
Load at height of 23".125	pounds.. 4.610
Height at load of 5,000 pounds	inches.. 22.76
Inner spring No. 1:	
Free height	do... 21.15
Load at height of 19".375	pounds.. 4.020
Height at load of 5,000 pounds	inches.. 18.98

Outer spring No. 1 and inner spring No. 1 closed down for a period of 50 hours.

Free height after release, No. 1, outer	inches.. 27.43
Free height after release, No. 1, inner	do... 21.10

After an interval of 4 days springs No. 1 were again tested, as follows:

Outer spring No. 1:	
Load at height of 23".125	pounds.. 4.400
Height at load of 5,000 pounds	inches.. 22.54
Free height	do... 27.43
Inner spring No. 1:	
Load at height of 19".375	pounds.. 3.860
Height at load of 5,000 pounds	inches.. 18.91
Free height	do... 21.07

FINAL LOADING WITH 11,000 POUNDS.

OUTER SPRINGS.

	No. of spring.			
	1.	2.	3.	4.
Load at height of 17".50	9.930	9.870	9.900	9.820
Height at load of 11,000 pounds	16.92	16.94	16.93	16.80
Final free height	27.43	27.62	27.64	27.63

INNER SPRINGS.

	No. of spring.			
	1.	2.	3.	4.
Load at height of 17".05	9.120	8.940	9.580	10.280
Height at load of 11,000 pounds	16.80	16.65	16.83	16.87
Final free height	21.07	21.06	21.12	21.88

HELICAL SPRINGS.

COUNTER RECOIL SPRINGS FOR 7-INCH MORTAR CARRIAGES.

COMPRESSION TESTS.

Sixty springs from a lot of 232 received February 9, 1903.

DESCRIPTION OF ONE SPRING.

Free height	inches..	18.80
Exterior diameter.....	do...	5.08
Diameter of wire.....	inch..	.70
Distance between coils.....	do...	.86
Weight		18 pounds, 12½ ounces

TEST OF ONE SPRING.

Free height.	Load at 15".	Height at 1,200 pounds.	Load at 9".5.	Closed down.		Load at 9".5.	Height at 1,200 pounds.	Load at 15".	Free height.
				Height.	Load.				
<i>Inches.</i> 18.80	<i>Pounds.</i> 1,250	<i>Inches.</i> 15.12	<i>Pounds.</i> 2,920	<i>Inches.</i> 9.08	<i>Pounds.</i> 3,500	<i>Pounds.</i> 2,900	<i>Inches.</i> 14.60	<i>Pounds.</i> 1,090	<i>Inches.</i> 18.78
Returned to machine.									

Springs closed down to height of 9".5, after which they were loaded in accordance with specifications.

No. of spring.	Free height.	Height at 1,200 pounds.	No. of spring.	Free height.	Height at 1,200 pounds.
	<i>Inches.</i>	<i>Inches.</i>		<i>Inches.</i>	<i>Inches.</i>
1.....	18.43	14.73	31.....	18.55	14.98
2.....	18.56	14.93	32.....	18.37	14.70
3.....	18.63	14.84	33.....	18.40	14.73
4.....	18.65	15.03	34.....	18.73	15.07
5.....	18.70	15.21	35.....	18.48	14.72
6.....	18.63	14.96	36.....	18.64	14.94
7.....	18.43	14.85	37.....	18.72	15.14
8.....	18.66	15.20	38.....	18.60	15.00
9.....	18.60	14.71	39.....	18.72	15.03
10.....	18.45	14.66	40.....	18.70	15.03
11.....	18.62	15.06	41.....	18.60	14.97
12.....	18.50	14.70	42.....	18.58	15.00
13.....	18.64	15.05	43.....	18.46	14.78
14.....	18.75	15.05	44.....	18.78	15.17
15.....	18.54	14.81	45.....	18.42	14.80
16.....	18.63	14.98	46.....	18.81	15.09
17.....	18.48	14.87	47.....	18.59	15.00
18.....	18.62	14.82	48.....	18.43	14.78
19.....	18.65	15.11	49.....	18.32	14.58
20.....	18.61	14.94	50.....	18.72	15.00
21.....	18.58	14.82	51.....	18.52	14.88
22.....	18.60	15.17	52.....	18.73	15.10
23.....	18.50	14.72	53.....	18.74	15.60
24.....	18.62	15.03	54.....	18.43	14.74
25.....	18.69	15.02	55.....	18.52	14.81
26.....	18.42	14.65	56.....	18.52	14.81
27.....	18.71	15.10	57.....	18.58	14.78
28.....	18.81	15.16	58.....	18.48	14.84
29.....	18.71	15.10	59.....	18.70	15.00
30.....	18.32	14.58	60.....	18.49	14.90

Springs Nos. 1 to 20, inclusive, closed down to a height of 9" 5, and so remained for a period of 64 hours. Immediately after their release the free heights were measured, and again later, after remaining unloaded 48 hours.

No. of spring.	Free heights.		
	Before closing.	After closed 64 hours.	48 hours after release.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
1.....	18.41	17.95	17.96
2.....	18.66	18.46	18.46
3.....	18.55	18.45	18.46
4.....	18.64	18.60	18.60
5.....	18.72	18.59	18.60
6.....	18.63	18.55	18.56
7.....	18.50	18.32	18.33
8.....	18.70	18.59	18.63
9.....	18.63	18.54	18.53
10.....	18.40	18.28	18.23
11.....	18.61	18.55	18.53
12.....	18.61	18.30	18.38
13.....	18.73	18.57	18.60
14.....	18.80	18.61	18.64
15.....	18.60	18.48	18.51
16.....	18.69	18.59	18.55
17.....	18.50	18.35	18.35
18.....	18.58	18.45	18.40
19.....	18.70	18.54	18.51
20.....	18.68	18.62	18.59
Mean heights	18.61	18.42	18.47
Total difference .....		.19	.14

Again loaded in accordance with the specifications.

No. of spring.	Free height.		No. of spring.	Free height.	
	<i>Inches.</i>	<i>Inches.</i>		<i>Inches.</i>	<i>Inches.</i>
1.....	17.96	14.19	11.....	18.53	14.99
2.....	18.46	14.80	12.....	18.38	14.62
3.....	18.46	14.76	13.....	18.60	15.05
4.....	18.60	14.93	14.....	18.64	15.00
5.....	18.60	15.08	15.....	18.51	14.78
6.....	18.56	14.88	16.....	18.55	14.94
7.....	18.33	14.77	17.....	18.35	14.79
8.....	18.63	15.16	18.....	18.40	14.80
9.....	18.53	14.68	19.....	18.51	15.04
10.....	18.33	14.56	20.....	18.59	14.89

When remeasuring the springs 48 hours after release from the state of being closed down, it was noticed that an apparent difference in height of ".07 could be given some springs, according to the side on which they lay when being measured. This was owing to the fact that the axes of some springs were not straight lines, and their weights tended to straighten them while in some positions. This probably explains why the final heights of some appear less than the heights immediately after release from the closed state. The tests for sustaining power, heights under load of 1,200 pounds compression, were made 48 hours after release from closing down.

HELICAL SPRINGS.

ADDITIONAL TESTS OF 16 SPRINGS.

No. of spring.	Free height.	Height at 1,200 pounds.	No. of spring.	Free height.	Height at 1,200 pounds.
	<i>Inches.</i>	<i>Inches.</i>		<i>Inches.</i>	<i>Inches.</i>
1.....	18.69	15.00	9.....	18.70	15.02
2.....	18.83	14.97	10.....	18.83	15.15
3.....	18.74	15.12	11.....	18.81	15.10
4.....	18.73	15.04	12.....	18.74	14.98
5.....	18.52	14.82	13.....	18.82	15.14
6.....	18.62	14.89	14.....	18.69	14.98
7.....	18.99	15.04	15.....	18.76	15.10
8.....	18.66	14.68	16.....	18.58	14.71

COUNTER PREPONDERANCE DEVICE SPRING FOR 10-INCH DISAPPEARING CARRIAGES, MODEL 1901.

MANUFACTURED AT WATERTOWN ARSENAL.

DIMENSIONS.

Height.....	inches..	15.25
Diameter of wire.....	inch..	.89
Outside diameter.....	inches..	5.50
Distance between coils.....	inch..	.55
Weight.....	pounds..	27.50

Applied loads.	Height.	Remarks.
<i>Pounds.</i>	<i>Inches.</i>	
0	15.25	
2,300	12.47	
2,600	12.125	
4,800	9.96	Closed down.
Loaded 100 times, compressing the spring solid each time and releasing to a load of 2,300 pounds between each loading, after which the spring tested as follows:		
2,300	12.31	
2,400	12.125	
0	14.90	

No. 10558.

BUFFER SPRINGS FOR 75-MILLIMETER MOUNTAIN GUN CARRIAGES.

DESCRIPTION.

	Springs.	
	No. 1.	No. 2.
Free height.....	31.65	32.17
Number of coils.....	54 1/2	54 1/2
Pitch.....	.60	.59
Exterior diameter.....	2.21	2.21
Interior diameter.....	1.14	1.13
Ribbon.....	1/16 int.	1/16 int.
	↑ .077 ↑ .117	↑ .078 ↑ .116

BUFFER SPRINGS FOR 75-MILLIMETER MOUNTAIN GUN CARRIAGES—Con.

TEST OF THE SPRINGS.

	Applied loads.	Height.
First spring	<i>Pounds.</i>	<i>Inches.</i>
	117	21.10
	281	7.01
	306	6.50
	345	6.48
Second spring	111	21.10
	124	21.10
	285	7.01
	301	6.50
	111	21.10

Springs were closed down 100 times from a height of 21".1 to 6".5, after which they measured:

No. 1, heightinches.. 31.03
 No. 2, heightdo.... 31.66

Again tested as follows:

Height.	Loads sustained.	
	No. 1.	No. 2.
<i>Inches.</i>	<i>Pounds.</i>	<i>Pounds.</i>
21.10	113	133
7.00	270	301
6.50	288	313
21.10	108	125

Assembled in gun and gun fired two rounds. Returned to testing room and found to measure:

No. 1, heightinches.. 31.08
 No. 2, heightdo.... 31.94

Height.	Loads sustained.	
	No. 1.	No. 2.
<i>Inches.</i>	<i>Pounds.</i>	<i>Pounds.</i>
21.10	123	127
7.00	281	288
6.50	301	306
21.10	102	106

Free heights immediately after testing:

No. 1, heightinches.. 31.03
 No. 2, heightdo.... 31.72

Springs closed down to height of 6".5 each and so remained for a period of 72 hours, after which the free heights measured:

No. 1, heightinches.. 30.82
 No. 2, heightdo.... 31.13

Height.	Loads sustained.	
	No. 1.	No. 2.
<i>Inches.</i>	<i>Pounds.</i>	<i>Pounds.</i>
21.1	112	126
7.0	276	290
6.5	302	317
21.1	102	107

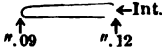
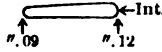
HELICAL SPRINGS.

No. 10625.

BUFFER SPRINGS FOR 75-MILLIMETER MOUNTAIN GUN CARRIAGES.

[Furnished April, 1903.]

DESCRIPTION.

	Springs.	
	No. 1.	No. 2.
Free height.....inches.....	30.35	30.10
Exterior diameter.....do.....	2.15	2.15
Interior diameter.....do.....	1.15	1.15
Ribbon.....		

TEST OF THE SPRINGS.

	Applied loads.	Height.	Remarks.	
	Pounds.	Inches.		
First spring.....	0	30.35	Closed down. Free height.	
	105	22.56		
	124	21.10		
	325	6.50		
	120	21.10		
	105	22.24		
	0	29.95		
	Spring closed down for a period of 48 hours:			
	0	29.6		
	Loaded 100 times from a height of 21 ^{n.1} to 6 ^{n.75} , after which the free height was:			
0	29.53			
Original test now repeated:				
105	21.9	Closed down.		
128	21.1			
326	6.5			
121	21.1			
105	21.9			
0	30.			
Second spring.....	0	30.10	Closed down. Free height.	
	105	22.68		
	112	21.1		
	316	6.65		
	118	21.1		
	105	21.8		
	0	29.5		
	Spring closed down for a period of 48 hours:			
	0	29.25		
	Loaded 100 times from a height of 21 ^{n.1} to 6 ^{n.75} , after which the free height was:			
0	28.77			
Original test now repeated:				
105	22.4	Closed down.		
114	21.1			
316	6.65			
109	21.1			
105	21.9			
0	29.85			

No. 10603.

HELICAL SPRINGS FOR COUNTERBALANCE DEVICE, 12-INCH DISAPPEARING CARRIAGE, MODEL 1901.

MANUFACTURED AT WATERTOWN ARSENAL.

Specifications require—

Diameter, outside.....	inches..	5.5
Diameter of wire.....	inch..	.875
At height of 14" ± 0".5 to sustain.....	pounds..	2,900
Free height not less than.....	inches..	17.8
Solid height, approximate.....	do..	10.5
Spring to be compressed 100 times * * * after which it shall support at least 2,900 pounds at height of.....	inches..	14 ± 0.5

Prior to the test it shall be compressed solid 60 hours.

TEST OF SPRINGS.

FIRST SPRING.

Spring closed down for a period of 49 hours, after which it tested as follow-:

Free height.....	inches..	17.09
Load at height of 14".5.....	pounds..	1,800
Height at load of 2,900 pounds.....	inches..	12.98
Height, closed down.....	do..	10.83
Load, closed down.....	pounds..	4,700

While unloading:

Height at load of 2,900 pounds.....	inches..	12.80
Load at height of 14".5.....	pounds..	1,690
Free height.....	inches..	17.07

After 24 hours' rest without load the height remained unchanged.

No. 10647.

SECOND SPRING.

Free height.....	inches..	17.66
Load at height of 14".5.....	pounds..	2,080
Height at load of 2,900 pounds.....	inches..	13.56
Height, closed down.....	do..	11.54
Load, closed down.....	pounds..	4,700
Height at load of 2,900 pounds.....	inches..	13.40
Load at height of 14".5.....	pounds..	2,100
Free height.....	inches..	17.76

No change in height after compressing 100 times.

No. 10609.

SPIRAL SPRINGS FOR LANYARD SAFETY FIRING DEVICE.

DESCRIPTION OF SPRINGS.

Marks.	Length of ribbon.	Cross-section dimensions.	Exterior diameter.
W.....	18 5	.628 × .025	3.95
N. Y.....	16 4	.625 × .025	3.27

The resistances of the springs were ascertained when each was uncoiled to 4 inches diameter, weighing the pull exerted at the outer end of the spiral at this size, and then after extending the end 2 and 3 feet, respectively, reducing the coiled part of the spiral these amounts.

TEST OF SPRINGS MARKED W.

No. of spring.	Resistance with end of spring extended—		
	0 feet.	2 feet.	3 feet.
1.....	<i>Pounds.</i> 2.25	<i>Pounds.</i> 4.00	<i>Pounds.</i> 4.75
2.....	1.75	3.25	3.50
3.....	1.50	3.00	5.00
4.....	1.25	2.50	3.00
5.....	1.50	3.00	4.25

TEST OF SPRINGS MARKED N. Y.

No. of spring.	Resistance with end of spring extended—		
	0 feet.	2 feet.	3 feet.
1.....	<i>Pounds.</i> 1.75	<i>Pounds.</i> 3.00	<i>Pounds.</i> 4.00
2.....	2.00	3.00	3.75
3.....	2.50	3.00	4.50
4.....	1.75	3.00	3.25
5.....	1.25	3.00	3.75

INTERNAL STRAINS IN GUN FORGINGS.



JACKET 33381 B₁.

5-INCH B. L. RIFLE, MODEL 1900.

BREECH SLICE.

Jacket was allowed to cool in pit, shut off from the air, but with no heat other than that of the forging itself.

State of internal strains and stresses at different phases of the slice.

SLICE INTACT.

Interior diameter of slice, 8".97; exterior diameter of slice, 15".10.

Rings.	Present mean diameters.	Strains.		Stresses per square inch.	
		Tension.	Compression.	Tension.	Compression.
	<i>Inches.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1.....	9.1184	.00155	.00425	5,100	8,600
2.....	14.90555				

BREECH SLICE.

Interior diameter, 8".97; exterior diameter, 15".10.

Original diameters of rings in the slice.

Rings.	Diameters.		
	A.	B.	Mean.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
1.....	9.1206	9.1164	9.11845
2.....	14.9113	14.8998	14.90565

RINGS DETACHED.

Rings.	Diameters.		
	A.	B.	Mean.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
1 detached.....	9.1193	9.1144	9.11685
2 detached.....	14.9270	14.8926	14.9098

JACKET 33381 B₄.

MUZZLE SLICE.

Bore, ".075 eccentric.

State of internal strains and stresses at different phases of the slice.

SLICE INTACT.

Interior diameter of slice, 9"; exterior diameter of slice, 12".45.

Rings.	Present mean diameter.	Strains.		Stresses persquare inch.	
		Tension.	Compression.	Tension.	Compression.
		<i>Inch.</i>	<i>Inch.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1.....	<i>Inches.</i> 9.13715	<i>Inch.</i> .0011	<i>Inch.</i> .0048	<i>Pounds.</i> 3,600	<i>Pounds.</i> 11,900
2.....	12.14945				

MUZZLE SLICE.

Interior diameter, 9"; exterior diameter, 12".45.

Original diameters of rings in the slice.

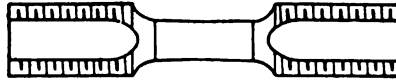
Rings.	Diameters.		
	A.	B.	Mean.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
1.....	9.1397	9.1346	9.13715
2.....	12.1450	12.1539	12.14945

RINGS DETACHED.

Rings.	Diameters.		
	A.	B.	Mean.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
1 detached	9.1379	9.1342	9.13605
2 detached	12.1628	12.1457	12.15425

Tangential specimens taken from middle of thickness of initial tension slice 5 a-b, from 5-inch experimental tube.

See report 1901, p. 361, for results on internal strains.



No. 7600.

FIRST SPECIMEN.

Diameter, ".383.

Sectional area, .1152 square inch.

Gauged length, 1".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.		Initial load.
5,000	0.		
10,000	.0002		
20,000	.0006		
30,000	.0009		
35,000	.0010		
40,000	.0011		
45,000	.0012		
47,000	.0013		
49,000	.0014		
50,000	.0015		Elastic limit.
1,000	0.		
51,000	.0085		
52,000	.0092		
53,000	.0107		
54,000	.0112		
55,000	.0122		
56,000	.0130		
57,000	.0140		
58,000	.0158		
59,000	.0167		Tensile strength.
60,000	.0185		
87,670			
0	.28		- 28 per cent.

Elongation of inch section, ".28.

Diameter at fracture, ".28; area, .0616 square inch.

Contraction of area, 46.5 per cent.

Appearance of fracture, silky.

No. 7601.

SECOND SPECIMEN.

Diameter, ".385.

Sectional area, .1164 square inch.

Gauged length, 1".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.		Initial load.
5,000	.0001		
10,000	.0003		
20,000	.0006		
30,000	.0009		
35,000	.0010		
40,000	.0011		
45,000	.0012		
49,000	.0014		Elastic limit.
50,000	.0028		
51,000	.0087		
52,000	.0091		
53,000	.0095		
54,000	.0101		
55,000	.0120		
56,000	.0125		
57,000	.0132		
58,000	.0139		
59,000	.0151		
60,000	.0165		
89,350			Tensile strength.
0	.30		= 30 per cent.

Elongation of inch section, ".30.

Diameter at fracture, ".28; area, .0616 square inch.

Contraction of area, 47.1 per cent.

Appearance of fracture, silky.

CHEMICAL ANALYSIS.

Carbon.	Manga- nese.	Silicon.	Sulphur.	Phospho- rus.
.50	.70	.22	.044	.026

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS.

Marks on specimens.	Description.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Crushhead	Inch.	Sq. inch.	Pounds.	Pounds.	Per cent.	Per cent.	" "	
1	Pivot yokes.....	.505	.20	43,500	81,500	24.5	49.1	14, 35*	Fine silky.
2	.....	.505	.20	43,500	78,600	24.5	49.1	23, 34*	Do.
3	.....	.505	.20	41,000	80,500	26.5	46.2	22, 30*	Do.
4	.....	.505	.20	47,000	83,500	28.5	59.6	17, 40*	Do.
5	.....	.505	.20	44,500	73,500	28.5	57.2	32*, 25	Do.
6	.....	.505	.20	42,000	76,550	28.5	51.9	15, 38*	Do.
7	.....	.505	.20	46,000	74,800	32.0	59.6	27, 37*	Do.
8	.....	.505	.20	43,750	72,200	30.0	57.2	40*, 17	Do.
9	.....	.505	.20	43,750	75,100	28.5	57.2	15, 42*	Do.
10	.....	.505	.20	41,000	67,000	32.0	51.9	40*, 24	Do.
11	.....	.505	.20	32,500	67,100	32.0	51.9	25, 39*	Do.
12	.....	.505	.20	32,500	67,100	32.0	40.2	34*, 21	Do.
13	.....	.505	.20	25,000	43,000	35.5	20.5	13*, 04	Do.
618-1	Elevating arm.....	.500	1.963	25,980	46,000	35.5	22.2	12, 38*	Dull silky, granular spots; blowhole.
618-2	Cap square.....	.500	1.963	20,620	36,620	23.5	22.4	14, 35*	Dull silky, 80 per cent; granular, 20 per cent.
618-3	Gun lever.....	.500	1.963	30,080	60,110	23.5	46.1	12, 37*	Granular, silvery luster, 90 per cent; dull silky, 10 per cent.
618-4	.....	.505	.20	37,500	68,000	19.5	46.1	19, 30*	Granular, 50 per cent; dull silky, 50 per cent.
618-5	.....	.505	.20	31,500	64,750	28.5	40.3	11, 28*	Do.
630-1	.....	.505	.20	29,000	64,500	24.0	40.3	11, 28*	Do.
630-2	.....	.505	.20	24,450	60,620	27.0	36.0	13*, 22	Dull silky, 40 per cent; granular, 60 per cent.
630-3	.....	.505	.20	27,000	60,750	6.5	16.9	08, 17*	Dull silky; Blowhole.
630-4	.....	.505	.20	26,000	62,250	12.5	23.9	15*, 10	Granular, silvery luster, 85 per cent; dull silky, 15 per cent.
630-5	.....	.505	.20	22,500	58,500	31.0	40.3	18, 34*	Granular, silvery luster, 60 per cent; dull silky, 40 per cent.
630-6	.....	.505	.20	22,500	64,750	20.0	43.3	18, 31*	Do.
630-7	.....	.505	.20	28,000	62,250	22.5	37.1	14, 14*	Dull silky; 60 per cent; granular, 40 per cent.
630-8	.....	.505	.20	28,000	69,000	9.0	27.4	04, 14*	Dull silky; granular spots.
630-9	.....	.500	1.963	21,450	59,600	25.5	32.3	20, 31*	Dull silky; granular spots; granular, 20 per cent.
630-10	.....	.505	.20	27,500	60,500	27.0	37.1	22, 32*	Dull silky; traces of granular.
630-11	.....	.505	.20	25,500	63,750	28.5	37.1	32*, 25	Dull silky; granular spots.
630-12	.....	.505	.20	31,000	67,750	16.5	16.9	16*, 17*	Granular, silvery luster, 80 per cent; dull silky, 20 per cent.
630-13	.....	.505	.20	37,500	68,000	14.5	16.9	12, 17*	Granular, silvery luster, 80 per cent; dull silky, 20 per cent.
618-11	Gun lever yoke.....	.505	.20	26,000	59,000	21.5	37.1	25*, 18	Dull silky, granular spots.
618-12	.....	.505	.20	27,500	60,500	21.5	40.3	19, 24*	Dull silky, 90 per cent; granular, 10 per cent.
630-1	.....	.500	1.963	24,960	60,800	26.5	36.0	25, 28*	Do.
630-2	.....	.500	1.963	26,470	64,700	17.0	22.5	15*, 16*	Do.
630-3	.....	.500	1.963	25,470	63,980	15.5	19.0	15, 16*	Do.
630-4	.....	.500	1.963	29,040	65,210	29.0	48.1	44*, 12	Do.
630-10	Gun lever.....	.500	1.963	26,500	64,500	30.0	46.2	18, 42*	Dull silky, 50 per cent; granular, 50 per cent.
630-19	Counterweight plate.....	.505	.20	27,500	67,750	15.0	16.9	13*, 12	Dull silky, 20 per cent; granular, 80 per cent.
630-24	Transom.....	.505	.20	27,500	67,750	15.0	16.9	13*, 12	Do.
634-5	Cap-square.....	.505	.20	27,000	64,750	16.0	16.9	16*, 16	Do.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on specimens.	Description.	Diam. eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Inch.	Sq. inch.	Pounds.	Pounds.	Per cent.	Per cent.	"	
634-6	Counterweight plate	.90	1.968	24,960	64,700	15.0	26.0	"	Dull silky; light seam near circumference.
641-1	Gun lever	.905	.20	23,500	65,500	21.0	16.9	18*, 12	Granular; silvery luster.
641-2	do	.905	.20	26,000	67,500	23.5	17.7	23*, 22	Silky; 85 per cent; granular, 15 per cent
641-7	Elevating band	.905	.20	21,500	62,000	24.0	30.7	21, 27*	Granular, 60 per cent; dull silky, 40 per cent
641-10	do	.905	.20	21,500	62,000	24.0	27.4	21, 22*	Granular, 70 per cent; dull silky, 30 per cent.
641-11	Transom	.905	.20	21,500	62,000	24.0	20.5	17, 17	Granular, silvery luster, 80 per cent; dull silky, 20 per cent.
641-13	Gun lever yoke	.905	.20	21,500	62,000	24.0	27.4	16, 23*	Dull silky; trace of granulation.
642-3	Gun lever	.905	.20	21,000	61,500	20.5	20.0	23*, 18	Granular, silvery luster, 85 per cent; dull silky, 15 per cent.
642-8	do	.905	.20	21,000	61,500	20.5	22.9	17, 23*	Granular, silvery luster, 85 per cent; dull silky, 15 per cent.
642-9	Elevating band	.905	.20	21,000	61,500	20.5	22.9	17, 23*	Granular, silvery luster, 85 per cent; dull silky, 15 per cent.
642-9	do	.905	.20	21,000	61,500	20.5	22.9	19, 26*	Amorphous; oblique.
639-2	Transom	.905	.20	21,000	61,500	20.5	22.9	16, 19*	Granular, 90 per cent; dull silky, 10 per cent.
648-1	Cap square	.905	.20	21,000	61,500	20.5	20.5	27*, 16	Granular, 90 per cent; dull silky, 10 per cent.
648-8	do	.905	.20	21,000	61,500	20.5	20.5	27*, 13	Granular, 90 per cent; dull silky, 10 per cent.
648-6	Counterweight plate	.905	.20	22,000	63,000	20.0	28.9	18*, 13	Granular, 90 per cent; dull silky, 10 per cent.
648-7	Gun lever	.905	.20	22,000	63,000	20.0	18.9	14, 17*	Granular, 90 per cent; dull silky, 10 per cent.
648-8	do	.905	.20	23,000	65,000	18.5	18.9	14, 17*	Granular, 90 per cent; dull silky, 10 per cent.
648-9	Racer clip	.905	.20	23,000	65,000	18.5	30.7	23, 24*	Granular; silvery luster.
648-11	do	.905	.20	22,000	64,000	20.0	30.7	21, 32*	Dull silky, 60 per cent; granular, 40 per cent.
648-13	Elevating rack	.905	.20	22,000	63,000	24.0	20.7	21, 27*	Dull silky; granular spot.
648-14	do	.905	.20	24,000	68,500	20.5	20.5	16, 19*	Granular, 90 per cent; dull silky, 10 per cent.
648-15	do	.905	.20	22,000	64,500	17.5	20.5	16, 19*	Granular, 85 per cent; dull silky, 15 per cent.
648-16	do	.905	.20	21,000	63,500	22.0	23.9	19, 25*	Granular, 75 per cent; dull silky, 25 per cent.
648-18	Racer	.905	.20	24,000	63,500	13.0	16.9	18*, 13	Granular, silvery luster.
652-1	Cap square	.905	.20	26,000	67,000	15.5	23.9	25*, 18	Granular, 50 per cent; dull silky, 50 per cent.
652-5	Elevating rack	.905	.20	23,000	62,000	21.5	30.7	25, 17	Granular, 10 per cent; dull silky, 90 per cent.
652-6	do	.905	.20	26,000	68,000	19.0	23.9	15, 23*	Granular, 80 per cent; dull silky, 20 per cent.
652-7	do	.905	.20	23,000	65,000	19.5	20.5	18, 21*	Granular, 50 per cent; dull silky, 50 per cent.
655-1	Racer	.905	.20	21,000	62,500	27.0	46.2	36*, 18	Silky.
655-2	do	.905	.20	23,000	65,000	19.0	20.5	22*, 16	Dull silky; granular spots.
656-3	Counterweight plate	.905	.20	23,000	65,000	18.0	16.9	16, 20*	Granular, silvery luster, 50 per cent; dull silky, 50 per cent.
657-8	Racer clip	.905	.20	22,000	65,500	18.0	20.5	16, 19*	Granular.
661-1	Racer	.905	.20	44,000	89,500	23.5	48.3	30, 38*	Silky.
641-4	Elevating band	.905	.20	32,000	69,000	18.0	30.7	24, 29*	Dull silky; trace of granulation.
641-6	do	.905	.20	33,000	67,500	26.5	30.7	19, 29*	Dull silky, 85 per cent; granular, 15 per cent.
642-9	Elevating arm	.905	.20	22,000	66,000	32.5	48.3	36*, 27	Dull silky; oblique.
648-24	Elevating rack	.905	.20	24,000	60,000	25.5	40.3	29*, 22	Dull silky; oblique.
652-9	do	.905	.20	24,000	60,000	25.5	48.3	25, 36*	Silky.
641-11	Transom	.905	.20	38,500	86,500	18.5	48.3	13*, 14	Smooth, oblique fracture.
641-13	Gun lever	.905	.20	32,500	66,000	13.5	23.9	20, 23*	Dull silky.
642-7	Elevating band	.905	.20	38,300	73,000	21.5	23.9	20, 23*	Dull silky.

648-5	Counterweight plate	.505	72,000	14.0	30.7	.02	.26*	Do.
641-3	Gun lever	.186	75,250	25.0	39.7	.17	.39*	Do.
641-14	Elevating arm	.605	30,500	18.5	30.7	.28*	.11	Dull silky, 80 per cent; granular, 20 per cent.
648-5	Counterweight plate	.600	64,250	30.0	42.1	.38*	.21	Dull silky, 75 per cent; granular, 25 per cent.
648-21	Elevating rack	.600	35,710	27.0	42.1	.32*	.22	Dull silky.
648-22	do	.600	39,800	29.5	45.2	.29	.30*	Do.
648-25	Racer	.605	37,500	19.5	20.5	.12	.19*	Smooth, oblique fracture.
652-12	Elevating rack	.605	72,500	19.5	30.7	.17	.12	Dull silky; trace of granulation.
652-13	Cap-square	.500	25.5	25.5	42.1	.20	.31*	Dull silky; granular spot.
655-4	Counterweight plate	.605	37,500	29.0	46.2	.39*	.19	Dull silky.
657-11	Elevating arm	.605	34,500	18.5	20.5	.17	.21*	Granular, 25 per cent; smooth surface, 75 per cent.
681-4	Crosshead	.605	23,470	22.5	35.9	.28*	.17	Dull silky, 50 per cent; granular, 50 per cent.
681-5	Racer	.605	38,600	21.5	27.4	.16	.27*	Dull silky; oblique.
681-6	do	.605	38,600	22.0	30.7	.17	.27*	Do.
682-5	Racer clip	.600	34,690	25.0	29.5	.22	.27*	Do.
682-6	do	.605	37,800	25.0	30.7	.22	.29*	Do.
682-7	do	.605	38,000	25.5	30.7	.22	.29*	Do.
682-8	do	.605	38,000	12.5	20.5	.20	.31*	Dull silky; oblique.
682-9	do	.605	38,000	26.0	40.3	.18	.14	Dull silky.
682-10	do	.605	38,000	26.0	40.3	.18	.14	Dull silky; oblique.
682-11	Racer clip	.605	71,000	26.0	40.3	.18	.14	Dull silky.
682-12	Racer clip	.605	64,800	31.5	43.3	.22	.27*	Dull silky.
682-13	do	.605	73,000	31.5	43.3	.22	.27*	Do.
682-14	Spiller cross	.605	67,500	29.5	43.3	.24	.27*	Do.
680-02	do	.605	96,500	29.5	43.3	.24	.27*	Do.
680-03	do	.600	23,210	19.5	11.5	.12	.19*	Granular, 90 per cent; dull silky, 10 per cent.
682-13	Gun lever	.605	23,270	19.5	11.5	.12	.19*	Granular, 85 per cent; dull silky, 15 per cent.
648-10	Racer clip	.600	68,800	39.0	43.3	.24	.27*	Silky.
648-11	Racer	.605	31,180	26.5	38.3	.20	.31*	Dull silky.
648-12	do	.605	32,500	26.5	38.3	.20	.31*	Dull silky.
648-13	Gun lever	.605	32,000	30.5	43.3	.20	.30*	Silky.
648-26	Racer	.605	37,500	30.5	43.3	.20	.30*	Silky.
655-3	do	.605	35,500	28.5	37.5	.14	.24*	Do.
655-4	do	.605	35,500	28.5	37.5	.14	.24*	Silky; oblique.
655-5	do	.605	35,500	28.5	37.5	.14	.24*	Silky.
659-2	Crosshead	.600	64,000	22.5	37.1	.31*	.14	Dull silky; oblique.
659-3	do	.600	67,500	22.5	40.2	.21	.37*	Do.
659-4	do	.600	64,800	19.0	20.5	.14	.24*	Do.
662-1	Racer	.605	36,220	26.5	42.1	.18	.35*	Dull silky.
662-2	do	.605	40,500	26.5	42.1	.18	.35*	Do.
662-3	do	.600	71,000	20.0	43.3	.30	.10	Do.
662-4	do	.600	64,000	22.0	30.7	.23*	.12	Granular, silvery luster, 50 per cent; dull silky, 50 per cent.
662-8	do	.600	68,370	22.0	45.2	.34*	.12	Silky, small granular spot.
676-2	Crosshead	.605	70,920	27.0	39.1	.20	.34*	Dull silky.
676-1	Racer	.605	23,500	27.0	28.9	.25*	.19	Granular; silvery luster; dull silky spot.
642-13	Gun lever	.605	33,500	29.0	43.3	.22	.36*	Dull silky; oblique.
648-19	do	.605	35,500	29.0	43.3	.22	.36*	Do.
655-5	Racer	.605	21,500	21.5	23.9	.22	.22*	Dull silky.
655-6	do	.605	21,500	18.5	20.5	.21*	.16	Granular, silvery luster, 85 per cent; dull silky, 15 per cent.
657-6	do	.605	63,500	15.0	30.7	.08	.22*	Dull silky; trace of granulation.
658-2	Crosshead	.605	28,000	23.5	27.4	.28*	.19	Dull silky, 50 per cent; granular, 50 per cent.
658-2	do	.605	28,000	22.0	30.7	.30*	.11	Dull silky, 40 per cent; granular, 60 per cent.
662-2	Racer	.605	28,500	13.0	20.5	.14*	.12	Dull silky (with blowhole), 80 per cent; granular, 70 per cent.
662-3	do	.605	37,000	29.0	37.1	.24	.34*	Dull silky; oblique.
662-4	do	.605	69,500	29.0	37.1	.27	.27	Dull silky; granular spots.
662-9	do	.605	21,500	27.5	46.2	.42*	.07	Dull silky.
663-4	Crosshead	.605	34,500	24.0	46.2	.27	.27	Dull silky.
675-2	Racer	.605	29,500	21.0	30.7	.19	.23*	Granular, 80 per cent; granular, 70 per cent.
682-1X	Cap square	.605	69,500	23.0	23.9	.19	.27*	Dull silky, 30 per cent; dull silky, 20 per cent.
682-3X	do	.605	40,500	23.5	23.9	.24*	.13	Fine granular, 60 per cent; dull silky, 40 per cent.
682-4X	do	.605	76,500	17.5	27.4	.22*	.13	Dull silky.
682-1X	Racer clip	.605	32,500	28.5	46.2	.35*	.22	Do.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on specimens.	Description.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	Sq. Inch.	Pounds.	Pounds.	Per cent.	Per cent.	Per cent.	"	"
668-2X	Racer clip	.505	29,000	67,500	19.0	27.4	14.	24*	Dull silky; granular spots.
685-3X	Pedestal	.505	21,500	68,500	16.0	16.9	14.	18*	Granular; white spot.
685-4X	do	.505	21,000	66,500	26.5	40.3	31*	19	Granular, 50 per cent; dull silky, 50 per cent.
690-1X	do	.505	37,500	71,000	10.0	20.5	.08	12	Dull silky; light, sandy spot.
690-2X	do	.505	26,500	64,500	18.0	37.1	.08	2*	Dull silky; granular spots.
641-15	Elevating arm.	.505	36,500	71,000	18.0	23.9	12.	21*	Dull silky, oblique.
641-16	Gun lever	.505	36,500	76,000	23.5	43.3	.33*	14	Dull silky, oblique.
641-17	do	.503	33,670	75,880	18.0	30.4	.23*	13	Dull silky, oblique.
667-10	Racer	.504	37,500	70,500	26.0	37.1	.07	12*	Dull silky; granular spot.
661-8	Racer	.505	32,500	59,500	9.5	9.5	.07	25*	Dull silky, blowhole.
668-2	Crosshead	.504	36,690	78,370	22.0	30.4	.23*	19	Dull silky.
676-8	Racer clip	.502	40,400	69,700	17.5	23.9	15.	33*	Dull silky.
679-6	do	.505	35,500	71,000	25.0	42.7	14.	36*	Dull silky.
684-02	Platform bracket.	.505	37,500	80,500	4.5	9.5	.08	06*	Granular, silvery luster, 60 per cent; dull silky, 40 per cent.
648-12	Racer clip	.505	30,500	79,000	10.5	16.9	10.	11*	Granular; silvery luster.
648-16	Elevating rack	.505	32,500	72,100	28.0	43.3	.33*	23	Granular; silvery luster.
648-20	Gun lever	.505	46,000	76,050	19.0	28.0	43.3	10.	Silky, oblique.
648-28	do	.505	36,000	76,800	24.0	37.1	19.	23*	Do.
648-29	do	.505	43,500	76,050	19.0	27.4	17.	21*	Do.
655-11	Racer	.505	33,000	68,000	22.0	30.7	16.	20*	Do.
657-12	Elevating arm.	.505	44,500	73,000	22.0	37.1	16.	25*	Silky, oblique.
680-01	Crosshead	.505	39,500	81,150	24.5	37.1	30*	19	Do.
680-04	do	.505	39,500	83,400	18.5	23.9	19.	15*	Silky.
700-2	Distance ring	.505	51,000	76,500	17.5	34.0	10.	55*	Do.
648-23	Elevating rack	.504	30,000	71,500	22.0	30.7	10.	57*	Silky, 80 per cent; granular, 20 per cent.
652-11	do	.505	37,500	70,100	23.5	34.0	19.	28*	Silky.
652-14	do	.505	43,000	72,900	23.5	34.0	25.	21*	Do.
655-10	do	.503	46,000	74,500	24.5	40.3	17.	32*	Silky.
659-3	Racer	.505	48,500	76,800	18.0	31.0	10.	25*	Silky, oblique.
662-10	Racer	.505	42,500	76,500	24.5	43.3	32*	17	Do.
676-5	Crosshead	.503	39,000	70,350	27.5	43.3	32*	25	Silky, oblique.
679-5	Stufing box	.505	41,500	81,000	19.0	34.0	28*	12	Do.
684-1	Racer	.505	34,500	69,700	18.0	27.4	13.	64*	Do.
685-1	Stufing box	.504	41,000	77,050	18.5	27.0	21.	09	Silky, 80 per cent; granular, 20 per cent.
686-1	Distance ring	.505	46,500	77,800	26.0	30.7	50*	32	Silky.
689-1	Stufing box	.505	38,250	69,400	26.0	37.1	25*	32	Do.
701-1	Distance ring	.505	38,500	69,100	11.5	16.9	10.	13*	Do.
641-18	Elevating arm	.505	44,800	76,550	21.0	34.0	15.	27*	Do.

641-20	Gun lever	655	20	78,500	34,050	34.0	28*	20*	Do.
642-12	...do	655	20	37,000	29,450	40.3	28	36*	Do.
642-14	Elevating arm	655	20	86,100	66,100	27.4	12	19*	Silky; dark-colored spot.
642-15	Gun lever	655	20	32,050	29,550	40.3	25	32*	Silky.
642-42	Platform bracket	655	20	32,000	29,550	49.1	20	39*	Do.
643-3	Buffer bracket	655	20	33,400	31,150	46.2	21	35*	Do.
646-2A	Pedestal	655	20	34,500	31,600	44.0	26	29*	Do.
649-01	Cap square	655	20	28,000	26,000	48.3	31*	13	Do.
649-1	Cradle	655	20	30,500	27,450	30.7	22*	29*	Silky; trace of granulation.
649-2	...do	655	20	30,500	26,500	31.9	31*	19	Granular, 60 per cent; silky, 40 per cent.
649-3V	Cradle	655	20	38,250	34,500	20.5	16	29*	Granular; dull spot at circumference.
649-4	...do	655	20	32,000	22,500	27.4	25	20	Silky; trace of granulation.
649-5	Pedestal	655	20	40,200	37,150	37.1	29*	21	Silky, 40 per cent; granular, 60 per cent.
649-6	...do	655	20	37,300	34,500	34.0	26*	23	Silky; trace of granulation.
649-7	Cradle	655	20	33,500	30,500	34.0	29*	23	Do.
649-8	...do	655	20	36,500	34,000	34.0	21	30*	Silky, 80 per cent; granular, 20 per cent.
649-9	Pivot yoke	655	20	33,500	30,000	23.9	23*	14	Broke in the thread.
649-10	...do	655	20	37,000	34,000	46.2	40*	16	Dull amorphous.
649-11	Cap square	655	20	38,000	35,300	49.1	21	40*	Silky; oblique.
649-12	Pedestal	655	20	39,200	36,600	27.4	20	29*	Do.
649-13	...do	655	20	38,500	35,500	27.4	16	22*	Silky.
649-14	...do	655	20	36,000	33,000	13.0	11	19*	Do.
649-15	Cradle	655	20	37,000	34,000	33.2	21	23*	Granular; silky spot.
649-16	Pedestal	655	20	37,000	34,000	34.0	26*	22	Silky.
649-17	...do	655	20	37,500	34,500	37.1	30*	25	Do.
649-18	...do	655	20	37,000	34,000	46.2	39*	22	Do.
649-19	...do	655	20	37,000	34,000	20.3	19*	11	Granular; dull silky spot.
649-20	...do	655	20	31,000	28,000	30.3	30*	12	Silky.
649-21	Cradle	655	20	41,500	37,500	34.0	14	29*	Silky; trace of granular.
649-22	Pedestal	655	20	41,000	37,500	30.7	20	24*	Granular; silky spot.
649-23	...do	655	20	42,500	39,000	30.7	17	26*	Silky.
649-24	...do	655	20	52,500	49,000	30.7	14	26*	Do.
649-25	Pivot yoke	655	20	43,500	40,000	17.0	12	26*	Do.
649-26	...do	655	20	43,500	40,000	16.6	13	15*	Granular; silky spot.
649-27	Pedestal	655	20	42,500	39,200	14.0	18	15*	Granular; 60 per cent; silky, 40 per cent.
649-28	...do	655	20	46,000	43,000	16.5	23	15*	Silky.
649-29	...do	655	20	43,500	39,750	18.0	18*	13	Granular, 70 per cent; silky, 30 per cent.
649-30	...do	655	20	40,500	37,000	10.5	10	14*	Silky.
649-31	Pivot yoke	655	20	39,300	36,400	20.0	20*	18	Do.
649-32	...do	655	20	34,000	31,000	14.0	16*	12	Do.
649-33	Pedestal	655	20	33,400	30,500	43.3	23	34*	Granular; dull spot.
649-34	...do	655	20	42,000	40,000	1.8	10*	04*	Silky; sand spot.
649-35	...do	655	20	44,300	42,000	8.5	10*	04*	Silky; sand spot.
649-36	Crosshead	655	20	44,300	42,000	22.5	20*	19	Granular; silky spot.
649-37	...do	655	20	47,000	44,500	37.1	16	29*	Silky.
649-38	Cradle	655	20	47,000	44,000	20.5	15*	07	Silky; sand spot.
649-39	...do	655	20	37,000	34,500	27.4	11	21*	Silky.
649-40	Pivot socket	655	20	37,000	34,500	1.8	04	04	Granular, 80 per cent; sand spot, 20 per cent.
649-41	...do	655	20	38,000	35,000	20.5	17	20*	Granular, 70 per cent; silky, 30 per cent.
649-42	Transom	655	20	31,500	28,500	23.9	19	29*	Silky; oblique; light spot.
649-43	Pedestal	655	20	38,000	35,000	27.4	26*	19	Silky; oblique.
649-44	...do	655	20	35,500	32,500	20.5	15*	08	Dull, amorphous; irregular.
649-45	Racer	655	20	11.6	11.6	20.5	15*	08	

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on specimens.	Description.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation		Contraction of area.	Elongation of inch sections.	Appearance of fracture.
						Per cent.	" "			
676-11	Racer.	.505	Sq. inch.	Pounds.	Pounds.	Per cent.	" "	Per cent.	" "	Dull silky.
682-08	Pedestal.	.505	20	36,000	66,600	15.5	21*	27.4	10	Granular, 60 per cent; silky, 40 per cent.
683-01	Racer clip.	.505	20	46,800	85,500	18.0	14*	18.9	16*	Granular.
685-1	do.	.505	20	38,000	77,000	18.0	12.2	18.9	16*	Granular, in part silky.
686-09	do.	.505	20	37,000	77,000	23.0	19*	27.7	20	Silky; oblique.
688-01	Pivot yoke	.505	20	31,500	75,200	22.0	27.7	30.5	18	Silky.
688-31	do.	.505	20	37,000	75,200	22.0	28*	30.7	19	Do.
688-41	do.	.505	20	37,000	75,200	21.0	27*	30.7	20	Do.
688-41	do.	.505	20	37,000	75,200	21.0	27*	30.7	20	Do.
708-41	Cap square	.505	20	24,500	57,500	20.5	24*	27.4	17*	Do.
708-41	do.	.505	20	24,500	57,500	20.5	24*	27.4	17*	Do.
708-08	Pivot yoke	.505	20	32,800	74,000	20.5	24*	31.0	11*	Do.
705-08	Cradle	.505	20	47,000	85,200	17.0	15*	20.5	10*	Dull silky; irregular.
705-3X	Pivot yoke	.505	20	47,000	85,200	17.0	15*	20.5	10*	Silky.
708-41	Pivot yoke	.505	20	36,500	82,750	24.5	21*	30.7	21*	Do.
708-41	Pivot socket.	.505	20	36,500	76,000	18.0	15*	20.5	21*	Do.
710-1X	Pedestal.	.505	20	39,000	77,300	20.5	19*	27.4	22*	Do.
710-2X	do.	.505	20	39,000	77,300	23.5	22*	30.7	25*	Do.
688-07	Pivot yoke	.505	20	39,500	78,000	19.0	27.4	27.4	23*	Do.
687-01	do.	.505	20	54,500	88,000	19.0	27.4	27.4	23*	Do.
687-02	do.	.505	20	49,000	88,100	18.5	20.5	19.9	17*	Do.
687-04	do.	.505	19	47,880	84,420	17.0	19.9	19.9	14*	Do.
687-04	do.	.505	20	44,500	82,800	14.5	19*	20.5	18*	Granular, 60 per cent; silky, 40 per cent.
686-03	Cradle.	.505	20	42,300	82,800	17.0	19*	20.5	19*	Silky; oblique.
676-04	do.	.505	20	38,800	77,900	20.5	28*	27.4	28*	Do.
686-08	Pivot yoke	.505	20	55,500	117,000	8.0	16.9	16.9	15*	Silky; irregular surface.
708-3X	Cap square	.505	20	20,500	44,750	80.0	46.2	21	39*	Silky; oblique.
706-02	Pivot yoke	.505	20	43,000	85,200	22.0	37.1	37.1	14*	Do.
706-41	Outer base.	.505	20	41,000	85,100	20.0	16*	23.9	16*	Silky, 60 per cent; granular, 40 per cent.
712-1X	Pedestal.	.505	20	48,500	98,500	5.0	65	65	24*	Defective; broke in thread.
712-3X	Pivot yoke	.505	20	38,000	68,500	26.5	38*	38*	15*	Silky.
712-1X	do.	.505	20	38,500	80,100	26.5	38*	38*	15*	Do.
713-01	Platform bracket.	.505	20	39,500	80,100	28.5	40.8	34*	19	Do.
713-03	do.	.505	20	36,500	70,500	27.5	43.8	30*	25	Do.
714-01	Cradle.	.505	20	44,000	60,500	84.5	51.9	49*	16	Silky; oblique.
714-02	do.	.505	20	44,000	77,450	28.0	37.1	19	31*	Silky.
714-1X	Pedestal.	.505	20	38,000	77,000	26.0	46.2	46.2	37*	Do.
714-2X	do.	.505	20	42,500	75,100	13.5	23.9	23.9	14*	Silky; light-colored spot.
714-3X	do.	.505	20	37,000	76,800	26.0	43.8	43.8	32*	Silky.
714-4X	Pivot yoke	.505	20	58,000	117,000	16.0	37.1	37.1	10*	Do.
714-4X	do.	.505	20	40,500	88,500	20.5	37.1	37.1	10*	Do.
714-DC	Deck circle.	.505	20	43,500	84,000	11.0	20.5	20.5	13*	Do.
715-01	Platform bracket.	.505	20	35,500	75,500	11.5	18.5	18.5	10*	Do.
717-01	Cap square	.505	20	24,800	60,200	33.5	46.2	46.2	40*	Silky.

717-03	Pivot yoke	505	20	41,500	75,500	20.5	84.0	18, 26*	Do.
717-04	do	505	20	41,000	74,100	26.5	87.1	38*, 19	Do.
718-01	Cradle	505	20	39,800	83,600	19.0	20.5	15, 27*	Granular, 60 per cent; silky, 40 per cent.
718-02	do	505	20	38,400	80,600	22.0	30.7	17, 27*	Do.
718-03	do	505	20	37,000	79,400	18.5	20.5	19*, 18	Do.
718-04	do	505	20	37,500	81,000	24.0	34.0	28*, 22	SILKY; trace of granulation.
718-05	do	505	20	38,000	82,500	17.5	24.0	19*, 15	Granular, 60 per cent; silky, 40 per cent.
719-01	Pivot yoke	505	20	36,000	80,500	14.5	30.5	07, 25*	SILKY; 80 per cent; granular, 20 per cent.
721-3X	Cap square	505	20	46,500	80,500	20.5	30.7	28*, 19	SILKY; oblique.
722-01	do	505	20	47,500	85,100	23.5	30.7	28*, 19	SILKY; oblique.
722-1X	Pedestal	505	20	49,400	85,600	25.0	31.0	17, 33*	Do.
722-2X	do	505	20	44,100	83,000	21.0	34.0	29*, 13	SILKY
723-01	Platform bracket	505	20	36,500	78,000	18.0	34.0	28*, 10	Granular, 60 per cent; silky, 40 per cent.
724-1X	Cap square	505	20	38,600	70,900	23.5	34.0	29*, 18	SILKY
728-2X	Pivot yoke	505	20	40,150	73,500	19.5	27.4	23*, 16	do
728-3X	Pedestal	505	20	45,700	79,000	11.5	20.5	12, 11	SILKY; sand spot. Fractured in neck.
727-1X	do	505	20	32,000	68,000	27.0	37.1	23, 31*	SILKY
729-05	Pivot yoke	505	20	39,600	78,100	17.5	30.7	15, 29*	do
735-1	Buffer bracket	505	20	41,000	79,400	21.5	23.9	25*, 18	SILKY; 60 per cent; granular, 40 per cent.
720-01	Cradle	505	20	38,000	85,400	15.5	20.5	14, 17*	SILKY; 55 per cent; granular, 45 per cent.
720-02	do	505	20	39,800	76,500	19.0	30.7	14, 24*	SILKY
721-01	Pivot yoke	505	20	43,800	81,500	24.0	34.0	25*, 23	SILKY; oblique.
728-02	Cradle	505	20	38,500	71,400	21.5	30.7	15, 29*	do
727-2X	do	505	20	37,000	79,000	17.0	30.7	11, 23*	SILKY; 70 per cent; granular, 30 per cent.
727-03	Cap square	505	20	33,000	60,500	25.0	37.1	15, 35*	SILKY; 60 per cent; granular, 40 per cent.
725-05	Pedestal	505	20	41,500	82,100	14.0	16.9	11, 17*	SILKY; 20 per cent; granular, 80 per cent.
725-06	do	505	20	34,800	70,900	19.5	27.4	19, 29*	SILKY; oblique.
735-16	do	505	20	29,100	68,400	24.0	30.7	29*, 19	Granular; silky spot.
685-7	do	505	20	47,000	75,300	25.0	34.0	28*, 22	SILKY
706-01	Pivot yoke	505	20	43,500	85,500	20.0	27.4	17, 23*	do
709-2	Distance ring	505	20	31,000	69,900	17.0	20.5	15, 19*	Granular; in part silky.
721-2X	Pedestal	505	20	39,000	78,100	22.5	34.0	14, 31*	SILKY
725-01	Cradle	505	20	38,000	72,000	25.0	37.1	30*, 20	Do.
729-01	do	505	20	42,500	83,100	19.0	23.9	24*, 14	Do.
729-02	do	505	20	42,500	84,900	21.0	34.0	28*, 14	Do.
730-05	do	505	20	34,600	76,500	16.0	20.5	15, 17*	Granular, 80 per cent; silky, 20 per cent.
738-06	do	505	20	39,300	76,500	24.5	37.1	18, 31*	SILKY
742-01	Pedestal	505	20	39,600	79,000	19.0	20.5	20*, 18	Granular, 50 per cent; silky, 50 per cent.
698-8A	Reroll sleeve	505	20	27,500	65,500	31.5	37.1	24*, 21*	SILKY
708-2A	do	505	20	39,200	79,000	31.5	46.2	41*, 22	Do.
712-5X	Cap square	505	20	39,000	79,000	24.5	30.7	29*, 20	SILKY; trace of granulation.
716-1	Distance ring	505	20	39,000	81,000	22.5	30.7	29*, 19	SILKY; 60 per cent; granular, 40 per cent.
716-2	do	505	20	46,500	71,500	18.0	27.4	06, 18*	Dull; silky; irregular surface.
724-A1	Pivot yoke	505	20	38,500	67,300	26.0	37.1	18, 34*	SILKY; oblique.
724-A2	do	505	20	63,000	82,000	22.0	30.7	16, 22*	Do.
727-01	do	505	20	34,760	71,500	20.5	27.4	20, 25*	Granular, 60 per cent; silky, 40 per cent.
727-02	do	505	20	34,200	71,400	22.0	27.4	18, 38*	SILKY
731-A1	do	505	20	47,500	78,600	28.0	49.1	18, 15	do
732-2X	Pedestal	505	20	41,500	74,000	16.5	23.9	18*, 15	SILKY; 60 per cent; granular, 40 per cent.
735-A1	Pivot yoke	505	20	35,100	72,000	18.5	30.7	18, 28*	SILKY; oblique.
735-08	do	505	20	32,500	69,500	25.0	30.7	27*, 23	SILKY; oblique.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on specimens.	Description.	Diam. eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Inch.	Sq. inch.	Pounds.	Pounds.	Per cent.	Per cent.	%	
698-6A	Outer base.....	.565	.20	38,700	74,000	19.0	20.5	18, 20*	Granular, 50 per cent; silky, 50 per cent.
698-7A	Recoil sleeve.....	.565	.20	38,100	75,300	24.0	27.4	.23, .25*	Granular, 70 per cent; silky, 30 per cent.
703-0X	Pedestal.....	.565	.20	40,100	80,500	12.5	16.9	.09, .10*	Granular; silky spot.
718-08	.....do.....	.565	.20	36,500	81,000	20.0	23.5	.23*, .17	Do.
718-01	Platform bracket.....	.565	.20	38,100	71,900	28.0	37.1	.28*, .24	Silky.
748-02	.....do.....	.565	.20	38,000	71,900	28.0	30.7	.18, .20*	Do.
748-05	.....do.....	.565	.20	35,500	67,000	28.0	37.1	.28, .26*	Do.
748-08	.....do.....	.565	.20	35,500	67,000	28.0	30.7	.18, .22*	Do.
745-2B	Cage.....	.565	.20	33,500	67,000	19.0	24.0	.16, .15	Do.
708-5Y	Pedestal.....	.565	.20	43,000	88,700	22.0	30.7	.30*, .14	Granular; silky spot.
708-6Y	.....do.....	.565	.20	39,250	76,900	22.5	30.5	.34, .19	Silky; 80 per cent; granular, 20 per cent.
708-7X	.....do.....	.565	.20	47,500	90,500	22.0	27.4	.29*, .20*	Granular; silky spot.
708-8X	Recoil sleeve.....	.565	.20	39,500	79,200	22.0	27.4	.29*, .28	Silky; 60 per cent; granular, 40 per cent.
709-1Y	Cap square.....	.565	.20	40,050	70,200	11.0	20.5	.14*, .08	Silky; 60 per cent; granular, 40 per cent.
731-01	Pivot yoke.....	.565	.20	36,500	69,300	20.0	27.1	.29*, .28	Granular; silky spot.
731-02	.....do.....	.565	.20	36,500	69,300	20.0	27.1	.31*, .27	Silky.
732-01	Pedestal.....	.565	.20	38,750	76,100	17.0	23.9	.13, .21*	Silky; oblique; sand spot.
732-1X	.....do.....	.565	.20	39,500	74,560	14.0	20.5	.18*, .09	Do.
735-01	Cradle.....	.565	.20	35,500	69,000	19.5	23.9	.18*, .20*	Granular; silky spot.
735-02	.....do.....	.565	.20	33,000	70,100	26.5	34.0	.31*, .20	Silky.
739-03	Pedestal.....	.565	.20	36,000	74,100	23.0	30.7	.27*, .19	Do.
739-04	.....do.....	.565	.20	34,900	73,000	27.0	37.1	.34*, .20	Do.
739-2B	Deck circle.....	.565	.20	37,000	66,000	5.5	9.5	.07*, .04	Granular; silky spot.
739-3B	.....do.....	.565	.20	36,000	65,100	9.5	13.2	.17, .22*	Granular, 60 per cent; silky, 40 per cent.
745-1X	Recoil sleeve.....	.565	.20	41,500	80,500	28.0	20.5	.17, .22*	Do.
745-1Y	Platform bracket.....	.565	.20	32,000	69,500	28.0	43.3	.26, .32*	Silky.
745-2X	.....do.....	.565	.20	34,900	68,500	27.5	40.8	.23, .30*	Do.
749-1X	.....do.....	.565	.20	30,500	65,900	27.5	40.8	.19, .30*	Do.
749-1Y	Gun lever yoke.....	.565	.20	33,600	63,500	18.5	27.4	.22*, .15	Do.
749-2	.....do.....	.565	.20	29,000	65,500	32.0	46.2	.31*, .33*	Silky; trace of granulation.
719-3	Buffer bracket.....	.565	.20	29,000	64,700	28.5	30.7	.29*, .22	Silky; oblique.
750-1B	.....do.....	.565	.20	35,500	74,000	26.5	43.8	.18, .37*	Do.
662-11	Racer.....	.602	.20	37,800	70,100	26.0	39.0	.35*, .15	Granular, 60 per cent; silky, 40 per cent.
662-12	.....do.....	.487	.186	35,400	66,770	25.5	39.0	.29*, .11	Silky; oblique.
694-01	Platform bracket.....	.565	.20	36,000	87,100	13.5	16.9	.12, .16*	Granular, 60 per cent; silky, 40 per cent.
735-08	Pivot yoke.....	.565	.20	32,550	69,700	24.0	20.0	.20, .29*	Granular, 60 per cent; silky, 40 per cent.
739-03	Pedestal.....	.565	.20	41,800	80,500	21.0	23.9	.27*, .11	Do.
739-04	.....do.....	.565	.20	43,000	79,500	19.0	27.4	.07*, .09*	Silky; trace of granulation; irregular.
739-4B	Deck circle.....	.565	.20	39,700	62,000	8.0	13.2	.19, .25*	Silky; granular intermingled.
742-03	Pedestal.....	.565	.20	42,000	82,600	22.0	30.7	.17, .31*	Granular, 60 per cent; silky, 40 per cent.
742-04	.....do.....	.565	.20	30,600	74,400	24.0	37.1		

744-02	.....do	20	84,900	78,550	24.0	37.1	30 ^o , 18	Silky.
751-1	Gun lever	20	28,500	61,600	24.5	43.3	36 ^o , 15	Do.
751-2	do	20	21,000	60,200	30.5	43.3	35 ^o , 25	Do.
751-3	do	20	27,000	60,500	28.5	43.3	21, 36 ^o *	Do.
751-4	do	20	25,500	61,000	29.0	43.3	36 ^o , 22	Do.
751-5	do	20	25,500	61,700	27.5	43.3	36 ^o , 19	Do.
751-6	do	20	24,800	61,000	32.0	43.3	36 ^o , 26	Do.
754-2B	Uage	20	45,000	84,600	6.0	5.7	07 ^o , 05	Medium coarse granular.
696-03	Cradle	20	38,500	77,600	10.0	16.9	11 ^o , 09	Dull silky; light-colored band.
696-05	do	20	34,600	72,300	19.5	37.4	08 ^o , 21	Silky; trace of granulation.
739-01	Platform bracket	20	38,000	82,000	25.5	27.4	20, 19	Do.
744-01	Pedestal	20	35,500	81,200	20.5	20.5	03 ^o , 15	Silky, 50 per cent; granular, 50 per cent.
744-04	Cradle	20	35,000	77,300	23.0	34.0	31 ^o , 15	Silky, 50 per cent; granular, 50 per cent.
745-3X	Platform bracket	20	37,000	81,000	17.5	34.0	08 ^o , 24	Silky.
746-01	Pedestal	20	36,000	81,000	20.5	20.5	18, 22*	Silky, 40 per cent; granular, 60 per cent.
746-02	do	20	44,000	81,900	14.5	16.9	14, 15*	Granular; silky spot.
746-03	do	20	37,000	80,100	14.5	16.9	14, 15*	Granular, 60 per cent; silky, 40 per cent.
750-1X	do	20	36,000	77,850	21.5	20.5	23 ^o , 20	Do.
750-2X	do	20	36,000	76,800	26.5	34.0	19, 32*	Silky.
751-8	Gun lever	20	28,000	60,600	30.0	46.2	41 ^o , 19	Do.
751-10	do	20	26,500	60,700	27.5	37.1	35 ^o , 20	Do.
752-1X	Pedestal	20	37,500	70,100	19.5	37.1	29 ^o , 11	Do.
752-2X	do	20	26,800	68,000	29.0	40.3	37 ^o , 21	Do.
754-2X	do	20	33,250	68,600	28.0	37.1	24, 32*	Do.
693-4X	do	20	41,000	80,200	17.5	28.9	19 ^o , 16	Granular, 55 per cent; silky, 45 per cent.
714-5X	do	20	29,000	73,500	14.0	20.5	17 ^o , 11	Silky.
726-7X	do	20	37,500	74,500	21.5	23.9	22 ^o , 21	Granular; silky patch.
754-1X	do	20	32,800	73,000	23.0	27.4	19, 26*	Silky.
761-1X	do	20	32,800	73,000	22.5	27.4	19, 26*	Do.
761-2X	do	20	31,000	68,000	24.5	30.7	28 ^o , 31	Granular; in part silky.
762-2X	do	20	29,500	72,900	23.0	30.7	18, 31*	Silky.
768-2X	do	20	29,500	72,900	23.0	30.7	23, 23*	Do.
768-3X	Pivot yoke	20	29,500	71,000	27.0	30.7	34 ^o , 20	Do.
763-3X	do	20	28,250	69,050	29.0	40.3	24, 34*	Do.
765-1X	Pedestal	20	29,500	72,000	20.5	23.9	17, 27*	Granular, 60 per cent; silky, 40 per cent.
765-2X	do	20	26,020	67,850	22.0	27.4	26 ^o , 18	Silky.
765-3X	do	20	31,000	71,600	25.0	30.7	24 ^o , 26*	Granular; silky patch.
765-4X	do	20	33,000	71,500	20.0	23.9	23 ^o , 17	Silky.
765-5X	Pivot yoke	20	30,500	72,500	23.0	23.9	23 ^o , 23	Granular, 50 per cent; silky, 50 per cent.
765-6X	do	20	30,750	71,000	15.5	20.5	12, 19*	Granular, 60 per cent; silky, 40 per cent.
685-9X	Pedestal	20	44,000	76,500	25.0	34.0	18, 32*	Silky; oblique.
685-10X	do	20	46,500	76,500	26.0	37.1	29 ^o , 23	Dull silky.
691-01	Cradle	20	46,500	84,900	12.5	16.9	11 ^o , 10	Silky, 50 per cent; granular, 50 per cent.
691-02	do	20	39,700	74,500	12.5	13.2	10, 15*	Silky, 60 per cent; granular, 40 per cent.
693-3X	Pedestal	20	40,000	79,800	10.0	13.2	09, 11*	Granular; silky spot.
705-09	Pivot yoke	20	39,500	77,700	19.0	20.7	12, 26*	Silky.
714-7X	Pedestal	20	36,500	75,100	27.5	43.3	25, 30*	Do.
724-2X	Cap-square	20	39,000	81,500	21.0	23.9	20	Dull silky; irregular.
724-3X	do	20	40,500	84,250	15.0	20.5	18 ^o , 12	Silky; trace of granulation.
732-04	Pedestal	20	39,500	76,500	25.5	34.0	31 ^o , 20	Silky.
686-8X	do	20	46,500	74,250	28.0	43.3	36 ^o , 20	Do.
693-012	do	20	34,500	84,000	5.0	13.2	08, 07*	Amorphous; oblique; dark spot.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on specimens.	Description.	Diam-eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Inch.	Sq. inch.	Pounds.	Pounds.	Per cent.	Per cent.	" "	
705-06	Cradle.....	.505	.20	48,000	87,300	21.5	27.4	"	Silky.
705-07	do.....	.505	.20	44,500	85,100	20.5	27.4	.17, .24*	Do.
705-10X	Pivot yoke.....	.505	.20	43,000	89,600	21.0	30.7	.16, .26*	Do.
716-3	Distance ring.....	.505	.20	39,000	88,900	22.0	31.0	.18, .31*	Do.
716-4	do.....	.503	.20	40,200	68,400	22.5	27.4	.19, .25*	Do.
725-04	Cradle.....	.505	.20	42,500	72,500	23.5	30.7	.30*, .17	Do.
727-04	Pivot yoke.....	.505	.20	34,000	82,000	20.0	23.9	.21*, .19	Granular, 70 per cent; silky, 80 per cent.
735-A2	do.....	.505	.20	74,000	92,600	7.5	20.5	.05, .10*	Silky; trace of granulation.
744-03	Cradle.....	.505	.20	35,500	78,600	23.5	30.7	.23*, .24	Silky.
759-1A	Pivot socket.....	.505	.20	31,500	71,800	25.0	30.7	.19, .31*	Do.
763-1B	Cage.....	.505	.20	33,500	74,000	24.5	27.4	.27*, .22	Silky; oblique.
618-16	Elevating arm.....	.505	.20	39,500	65,500	20.0	30.7	.24*, .16	Do.
652-7X	Pivot yoke.....	.505	.20	32,500	71,500	19.5	23.9	.14, .25*	Silky.
679-4	Stuffing box.....	.505	.20	40,200	85,300	17.0	23.9	.15, .19*	Silky; trace of granulation.
694-3	Distance ring.....	.505	.20	32,000	85,300	17.5	23.9	.21*, .14	Silky.
698-9A	Pivot socket.....	.505	.20	39,900	82,900	23.0	30.7	.27, .24*	Silky.
709-3	Distance ring.....	.505	.20	28,900	71,000	20.0	20.5	.18, .22*	Granular; silky spot.
709-4	do.....	.505	.20	31,500	72,000	16.0	16.9	.17*, .15	Granular.
761-7	Buffer bracket.....	.505	.20	30,500	64,800	30.0	43.8	.86*, .24	Silky.
753-1	Distance ring.....	.505	.20	25,000	62,000	18.5	23.9	.18, .19*	Dull silky; irregular.
757-7	Racer clip.....	.505	.20	23,000	61,300	25.5	27.4	.24, .27*	Granular; silky spot.
618-15	Elevating arm.....	.505	.20	41,500	68,300	28.5	46.2	.32*, .25	Silky; oblique.
618-17	do.....	.505	.20	41,700	68,100	23.0	37.1	.26*, .20	Do.
698-010	Pivot yoke.....	.505	.20	39,500	81,700	18.5	27.4	.22*, .15	Silky.
698-10A	Inter base.....	.505	.20	34,200	72,600	17.0	30.7	.23*, .11	Do.
705-06	Pivot yoke.....	.505	.20	38,000	76,200	20.0	27.4	.22*, .18	Do.
712-6X	Pedestal.....	.505	.20	49,000	95,600	13.5	13.2	.15*, .12	Granular, 80 per cent; silky, 20 per cent.
712-7X	do.....	.505	.20	40,500	81,600	19.0	20.5	.17, .21*	Granular, 40 per cent; silky, 60 per cent.
712-9X	do.....	.505	.20	44,500	76,000	17.5	23.9	.20*, .15	Do.
721-5X	do.....	.505	.20	39,200	86,000	16.0	34.0	.25*, .07	Silky.
728-06	Pivot yoke.....	.505	.20	41,500	79,900	23.5	34.0	.25, .26*	Do.
732-3X	Pedestal.....	.505	.20	41,700	77,500	23.5	30.7	.23*, .18	Do.
732-5X	do.....	.505	.20	42,500	78,600	23.5	30.7	.18, .29*	Do.
742-06	do.....	.505	.20	37,600	82,500	19.0	23.9	.21*, .18	Granular.
742-08	do.....	.505	.20	38,000	68,100	18.5	20.5	.17, .20*	Granular; silky spot.
752-1	Stuffing box.....	.505	.20	34,000	67,500	31.5	46.2	.35*, .28	Silky.
706-2X	Cap square.....	.505	.20	33,000	74,000	22.5	23.9	.23*, .22	Granular, 60 per cent; silky, 40 per cent.
708-06	Platform bracket.....	.505	.20	46,000	85,600	11.0	13.2	.11, .11*	Granular; silky spot.
709-01	do.....	.505	.20	30,500	68,000	28.0	24, .32*	.24, .32*	Silky.
727-05	Cap square.....	.505	.20	34,500	72,000	28.5	40.3	.20, .37*	Do.
766-1	Platform support.....	.505	.20	32,000	60,300	28.0	46.2	.16, .37*	Do.

770-1X	Pedestal.....	505	20	38,500	72,600	26.5	43.3	35*, 18	Do.
770-2X	do.....	505	20	41,000	75,200	11.6	23.9	.09, .14*	Do.
774-2X	do.....	505	20	34,500	76,000	34.0	30.7	.25*, 23	Do.
774-3X	do.....	505	20	36,000	76,600	19.0	20.5	17, .21*	Granular; silky spot.
774-4X	do.....	505	20	31,000	76,500	10.6	34.0	28*	Silky; trace of granulation.
774-5X	do.....	505	20	49,000	90,500	21.5	18.2	10, .11*	Granular, 70 per cent; silky, 30 per cent.
775-1	Gun lever.....	505	20	31,500	65,100	26.5	37.1	.26, 27*	Silky; trace of granulation.
775-2	do.....	505	20	29,000	65,500	30.0	43.3	35*, 25	Do.
775-3	do.....	505	20	26,500	65,100	29.0	43.3	35*, 22	Silky, 60 per cent; granular, 50 per cent.
775-4	do.....	505	20	25,000	65,400	25.5	37.1	.31*, 22	Silky.
775-5	do.....	505	20	32,500	63,400	26.5	37.1	.31*, 22	Do.
775-6	do.....	505	20	29,500	66,100	26.5	34.0	.22, 29*	Do.
688-06	Pedestal.....	505	20	39,000	80,100	20.0	30.7	18, 22*	Silky; trace of granulation.
688-07	do.....	505	20	37,000	80,600	12.5	13.2	12, 13*	Granular, 70 per cent; silky, 30 per cent.
688-09	do.....	505	20	46,500	90,100	17.5	20.5	16, 19*	Granular, 60 per cent; silky, 40 per cent.
721-04	Pivot yoke.....	505	20	40,500	70,600	29.0	34.0	.26*, 28*	Silky; oblique.
721-04	Pedestal.....	505	20	43,000	85,100	18.0	23.9	.22*, 14	Silky; irregular; oblique.
728-00	do.....	505	20	44,500	84,700	22.0	34.0	.26*, 16	Silky.
728-01	do.....	505	20	41,000	71,500	27.0	37.1	.20, 34*	Do.
728-02	do.....	505	20	32,500	71,900	22.5	34.0	.30*, 16	Do.
728-03	do.....	505	20	32,500	82,000	16.5	27.4	11, 22*	Do.
728-04	do.....	505	20	34,000	84,900	25.5	34.0	19, 32*	Granular, 60 per cent; silky, 40 per cent.
728-05	Platform bracket.....	505	20	24,000	64,900	25.5	34.0	.22, 22*	Silky.
728-06	Pivot yoke.....	505	20	46,000	82,600	22.0	30.7	.28*, 19	Do.
728-07	do.....	505	20	41,500	82,150	23.5	30.7	.30*, 27*	Granular; silky spot.
728-08	do.....	505	20	36,000	72,000	27.5	27.4	.24*, 14	Silky; irregular; oblique.
728-09	do.....	505	20	36,000	75,700	19.0	30.7	.27*, 15	Silky, oblique.
728-10	Pedestal.....	505	20	32,000	80,600	21.0	37.1	.24, 33*	Do.
728-11	do.....	505	20	31,400	72,500	26.0	40.3	.26*, 07	Do.
728-12	do.....	505	20	37,000	73,000	18.0	34.0	.30*, 20	Do.
728-13	Cage.....	505	20	37,000	73,500	25.0	34.0	.30*, 20	Do.
728-14	do.....	505	20	34,000	72,500	19.5	13.2	14, 16*	Do.
728-15	do.....	505	20	31,500	72,500	13.5	13.2	14, 16*	Do.
728-16	do.....	505	20	34,500	72,500	12.0	13.2	16, 17*	Do.
682-1X	Cradle.....	505	20	41,500	82,000	18.0	23.9	16, 31*	Do.
682-01A	Pedestal.....	505	20	54,500	84,500	10.0	23.9	16, 31*	Granular, 60 per cent; silky, 40 per cent.
682-01B	do.....	505	20	48,000	84,500	10.0	23.9	16, 31*	Silky; oblique.
682-01C	do.....	505	20	48,000	83,700	9.5	13.2	.07, 31*	Silky; sand spot.
682-01D	do.....	505	20	39,000	71,000	9.0	13.2	.07, 31*	Silky.
682-01E	Outer base.....	505	20	38,000	71,000	15.0	23.9	16*, 11	Do.
729-68	Platform bracket.....	505	20	38,000	72,500	15.0	23.9	16*, 11	Do.
731-06	Platform bracket.....	505	20	41,500	73,000	23.0	27.4	18, 26*	Silky; small blowholes.
732-02	Platform bracket.....	505	20	37,500	60,200	22.5	27.4	18, 26*	Do.
732-03	do.....	505	20	37,500	63,050	6.5	16.9	.06*, 05	Silky.
732-04	Cage.....	505	20	55,000	84,000	24.5	27.4	19, 26*	Do.
732-05	do.....	505	20	44,500	80,500	22.5	27.4	19, 26*	Do.
732-06	do.....	505	20	38,500	77,000	22.5	30.7	21, 24*	Silky; irregular.
732-07	do.....	505	20	38,000	75,000	16.5	20.5	14, 18*	Silky, 40 per cent; granular, 60 per cent.
684-14	Counterweight plate.....	505	20	31,000	69,500	27.5	40.3	.30, 20	Silky, 60 per cent; granular, 40 per cent.
684-15	do.....	505	20	36,500	68,500	20.0	43.3	.22, 36*	Silky.
754-3X	Transom.....	505	20	31,000	64,500	20.0	40.3	.22, 36*	Silky; small, light spots.
754-3X	Pedestal.....	505	20	48,500	79,000	16.0	23.9	15, 14	Silky; oblique.
761-4X	do.....	505	20	40,500	81,000	22.5	30.7	16, 25*	Granular, 70 per cent; silky, 30 per cent.
765-9X	do.....	505	20	39,500	83,500	18.5	20.5	15, 22*	Silky.
767-6	Gun lever.....	505	20	34,000	68,500	26.0	30.7	25*, 27*	Granular, 80 per cent; silky, 20 per cent.
682-7X	Pedestal.....	505	20	40,500	82,000	15.5	20.5	20*, 11	Do.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Mark's on specimens.	Description.	Diam-eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elonga-tion in 2 inches.	Contra-c-tion of area.	Elongation of inch sections.	Appearance of fracture.
	Inch.	Sq. Inch.	Pounds.	Pounds.	Per cent.	Per cent.	Per cent.	" "	
686-017	Pivot yoke	.565	20	48,500	88,000	13.5	20.5	11, 16*	Silky; trace of granulation.
704-3A	Recoil sleeve	.565	20	49,500	91,000	20.0	23.9	24*, 16	Granular; silky spot.
718-02	Platform bracket.	.565	20	42,000	82,600	23.5	30.7	27*, 20	Silky; trace of granulation.
735-010	Pivot yoke	.565	20	42,000	80,100	21.0	28.9	25*, 17	Silky; 60 per cent; granular, 40 per cent.
744-06	Cradle	.565	20	41,500	79,000	13.5	13.2	13*, 12	Granular; silky spot.
744-08	do.	.565	20	41,000	80,200	20.0	28.9	19, 21*	Granular, 80 per cent; silky, 20 per cent.
752-32X	Pedestal.	.565	20	47,500	76,000	23.0	40.3	15, 31*	Silky.
752-33X	do.	.565	20	43,000	80,500	15.0	27.4	21*, 09	Silky; in part granular.
774-6X	do.	.565	20	31,000	74,900	25.0	23.9	23, 27*	Granular; silky spot.
774-8X	do.	.565	20	46,000	86,500	22.0	32.9	18, 26*	Silky; irregular; oblique.
780-1X	Cradle	.565	20	40,500	87,000	12.5	13.2	10, 15*	Granular; silky spot.
780-2X	do.	.565	20	28,000	67,000	26.5	43.3	37*, 16	Silky; trace of granulation.
780-3X	Racer.	.565	20	28,000	68,500	27.5	37.1	35*, 30	Silky.
780-4X	do.	.565	20	29,000	68,000	23.5	30.7	21, 30*	Granular; in part silky.
780-5X	do.	.565	20	42,000	71,500	28.5	37.5	33*, 24	Silky.
780-6X	do.	.565	20	41,500	72,000	18.5	16.2	18*, 19	Do.
780-7X	do.	.565	20	41,500	75,000	13.5	18.9	13*, 18	Do.
780-8X	Pivot yoke	.565	20	34,500	68,500	11.0	13.5	15*, 15	Granular; silky spot.
780-9X	do.	.565	20	39,500	92,000	12.0	20.5	14*, 14	Granular; silky spot.
780-10X	do.	.565	20	29,200	71,000	19.0	13.2	13*, 11	Do.
780-11X	do.	.565	20	39,500	84,500	26.5	23.9	19, 24*	Silky.
780-12X	do.	.565	20	38,500	84,500	26.5	43.3	29*, 24	Do.
780-13X	Cradle	.565	20	30,500	72,000	18.5	20.5	17, 30*	Silky; oblique.
698-019	Cradle	.565	20	41,500	79,000	27.5	37.1	23, 26*	Silky.
786-1X	Cradle	.565	20	31,000	66,500	18.5	30.7	11, 26*	Do.
786-2X	do.	.565	20	50,500	86,000	17.5	23.9	24*, 13	Do.
786-3X	Distance ring	.565	20	47,000	82,500	24.5	34.0	19, 30*	Do.
786-4X	Pedestal.	.565	20	40,000	74,000	20.5	27.4	17, 24*	Do.
786-5X	do.	.565	20	42,000	75,000	20.5	23.9	17, 24*	Do.
786-6X	do.	.565	20	43,000	81,400	20.5	23.9	22*, 19	Silky; 50 per cent; granular, 50 per cent.
786-7X	Pedestal	.565	20	37,000	92,000	9.0	9.5	10*, 08*	Granular.
786-8X	do.	.565	20	42,000	81,500	23.0	27.4	25*, 21*	Silky.
786-9X	Sleeve bracket	.565	20	44,000	71,500	18.0	20.5	20*, 16	Do.
786-10X	Crosshead	.565	20	34,500	74,000	25.5	37.1	24, 27*	Do.
787-1X	Platform bracket.	.565	20	27,000	72,500	23.5	27.4	23*, 24*	Granular, 40 per cent; silky, 60 per cent.
787-2X	Pivot yoke	.565	20	27,000	75,000	21.5	20.5	19, 24*	Granular; silky spot.
789-2X	do.	.565	20	29,500	63,000	30.0	43.3	31*, 26	Silky.
790-3X	Platform bracket.	.565	20	27,000	70,300	28.0	37.1	34*, 22	Do.
786-11X	Cap square	.565	20	33,000	69,500	17.5	23.9	15, 20*	Do.
786-12X	Platform bracket.	.565	20	28,500	68,500	24.5	27.4	24, 25*	Granular; silky spot.

757-3X	Cap square.....	505	20	27,500	68,500	26.5	30.7	32*, 21	Granular, 60 per cent; silky, 40 per cent.
758-1X	do.....	505	20	21,500	53,700	83.5	46.2	37*, 30	Silky.
760-1X	do.....	505	20	20,500	50,500	29.5	40.3	26, 23*	Do.
760-2X	Platform bracket.....	505	20	23,000	61,500	84.0	49.1	43*, 25	Do.
761-1X	do.....	505	20	26,000	66,500	25.0	30.7	33*, 20	Granular.
761-2X	do.....	505	20	32,000	74,900	26.0	34.0	22, 22*	Silky; trace of granulation.
765-1	Racer clip.....	505	20	32,500	88,500	13.0	13.2	13, 13*	Granular.
768-1X	Cap square.....	505	20	30,000	79,000	16.6	20.5	23*, 13	Do.
663-12X	Pedestal.....	505	20	42,000	76,000	23.5	20.5	15, 32*	Silky.
696-018	do.....	505	20	41,000	75,600	19.0	23.9	14, 24*	Do.
700-8	Distance ring.....	505	20	48,000	82,200	20.5	27.1	23, 23*	Do.
703-10X	do.....	505	20	26,500	66,300	26.0	37.1	23, 23*	Do.
707-06	Pedestal.....	505	20	47,000	90,500	13.0	16.9	14*, 12	Silky, 40 per cent; granular, 60 per cent.
711-06	Cap square.....	505	20	44,000	96,600	19.0	26.9	17, 21*	Silky; irregular.
733-013	Pivot yoke.....	505	20	42,500	73,500	15.5	20.5	18*, 18	Granular; silky spot.
731-06	do.....	505	20	39,500	71,600	10.5	34.0	25*, 24	Silky.
738-014	Pedestal.....	505	20	44,500	79,000	26.5	20.5	09, 12*	Silky; sand spot.
738-06	do.....	505	20	43,500	82,500	25.5	34.0	23, 23*	Do.
738-07	do.....	505	20	61,000	86,500	15.0	27.4	21*, 09	Do.
765-15X	Pivot yoke.....	505	20	45,500	82,000	19.0	23.9	16, 22*	Do.
770-3X	Pedestal.....	505	20	41,500	80,100	26.5	34.0	27, 26*	Silky; oblique.
770-1X	do.....	505	20	37,500	75,500	11.5	23.9	15*, 08	Silky; sand spot.
779-2B	Deck circle.....	505	20	40,500	83,500	17.6	23.9	14, 21*	Silky.
781-01	Platform bracket.....	505	20	37,000	71,000	28.0	40.3	33*, 23	Do.
782-7X	Pedestal.....	505	20	33,500	83,500	13.6	13.2	16*, 11	Granular.
786-01	Crosshead.....	505	20	41,000	80,600	24.0	30.7	23, 25*	Silky; trace of granulation.
792-1X	Cap square.....	505	20	24,500	56,900	33.5	46.2	41*, 26	Silky.
794-1X	do.....	505	20	37,000	86,000	20.5	23.9	21*, 20	Granular, 60 per cent; silky, 40 per cent.
794-5X	do.....	505	20	31,000	79,000	22.5	23.9	21, 24*	Granular.
798-3X	Platform bracket.....	505	20	30,500	68,500	27.5	40.3	29*, 35	Silky; irregular.
798-4X	Cap square.....	505	20	43,000	81,000	22.5	30.7	17*, 28	Silky.
799-1X	Cap square.....	505	20	44,000	84,650	23.0	37.1	16, 30*	Do.
700-01	Platform bracket.....	505	20	50,500	89,600	10.5	13.2	10, 11*	Granular, 55 per cent; silky, 45 per cent.
708-11X	Cap square.....	505	20	47,000	77,500	23.5	34.0	17, 30*	Silky.
726-05	do.....	505	20	41,000	74,700	25.5	30.7	32*, 19	Do.
726-06	do.....	505	20	43,000	76,500	16.3	34.0	08, 25*	Do.
752-2	Stuffing box.....	505	20	39,500	79,900	23.3	34.0	23*, 24*	Do.
769-2A	Pivot socket.....	505	20	28,600	66,500	24.0	30.7	20, 23*	Granular; silky spot.
769-2B	Gun-lever yoke.....	505	20	32,500	71,000	30.0	43.3	38*, 22	Granular; silky spot.
772-03	Platform bracket.....	505	20	38,000	86,000	18.0	20.5	18*, 16*	Granular; silky spot.
782-0X	Cradle.....	505	20	34,500	74,000	21.5	27.4	19, 24*	Silky, 60 per cent; granular, 40 per cent.
785-1B	Deck circle.....	505	20	36,000	77,000	24.5	34.0	28*, 23	Silky; trace of granulation.
789-1B	do.....	505	20	35,500	80,100	21.5	27.4	24*, 19	Granular, 60 per cent; silky, 40 per cent.
793-1B	do.....	505	20	34,000	82,700	21.5	27.4	26*, 17	Granular.
794-2X	do.....	505	20	40,500	77,000	22.0	34.0	16, 28*	Silky.
801-1X	Cap square.....	505	20	40,500	79,000	20.0	27.4	24*, 16	Silky; irregular.
806-01	do.....	505	20	41,500	80,000	24.0	30.7	21, 27*	Silky.
691-03	Cradle.....	505	20	41,500	81,000	14.3	20.5	11, 19*	Silky; irregular.
691-04	do.....	505	20	24,800	60,500	25.0	37.1	35*, 21	Silky.
700-0X	Pedestal.....	505	20	24,000	60,500	25.0	20.5	18*, 07	Silky; sand spot.
767-4X	Platform bracket.....	505	20	31,500	68,000	13.0	16.9	15*, 11	Granular.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on specimens.	Description.	Diam-eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Inch.	Sq. inch.	Pounds.	Pounds.	Per cent.	Per cent.	" "	" "
788-3X	Pedestal	.505	.20	24,000	29,000	23.0	38.7	17.28*	Silky
788-4X	do	.505	.20	24,000	29,000	18.2	46.2	12.47	Granular.
790-4X	Platform bracket	.505	.20	24,000	31,500	31.5	36.7	25.37*	Silky
790-5X	do	.505	.20	24,500	31,000	24.0	30.5	27.21	Granular, 60 per cent; silky, 40 per cent.
727-07	Pivot yoke	.505	.20	40,500	48,000	15.0	20.5	17.16*	Silky; trace of granulation.
727-08	do	.505	.20	40,500	48,000	9.5	20.5	17.21*	Silky; irregular.
728-016	Cradle	.505	.20	38,000	47,500	13.0	23.9	9.18*	do.
728-017	Pivot yoke	.505	.20	41,500	51,700	18.5	27.4	12.21*	Granular, 50 per cent; silky, 50 per cent.
728-021	do	.505	.20	44,500	56,000	20.0	27.4	15.25*	Silky
728-022	Pedestal	.505	.20	44,500	56,000	24.5	30.7	28.21	do.
729-15	do	.505	.20	53,000	76,000	15.0	20.5	9.09*	Granular; silky spot.
729-16	Cage	.505	.20	48,000	64,000	8.0	16.9	0.76*	Granular.
815-32	Platform bracket	.505	.20	34,000	72,500	21.5	23.9	0.76*	Silky; trace of granulation.
816-3X	Elevating bracket	.505	.20	33,000	72,000	21.5	27.4	19.24*	Silky; oblique.
816-3X	Platform bracket	.505	.20	34,000	73,500	26.0	34.0	25.27*	Silky
816-3Z	do	.505	.20	33,000	73,000	23.0	34.0	28.18	do.
816-3	Spur gear	.505	.20	32,500	73,000	18.0	20.5	15.21*	Silky; granular spot.
816-3	do	.505	.20	35,500	73,000	26.0	34.0	22.36*	Silky
816-3	do	.505	.20	36,000	73,000	22.0	27.4	21.29*	do.
809-1V	Platform bracket	.505	.20	34,000	73,000	27.0	40.3	29.25*	do.
810-4V	do	.505	.20	36,000	73,000	23.5	34.0	19.29*	do.
789-5X	Pedestal	.505	.20	43,000	84,000	11.5	16.9	1.9.16	Granular, 80 per cent; silky, 20 per cent.
692-010	do	.505	.20	38,000	80,100	17.5	20.5	1.9.16	Granular; in part silky.
692-011	do	.505	.20	41,500	85,100	13.5	18.2	1.9.12	Granular, 60 per cent; silky, 40 per cent.
705-11X	do	.505	.20	47,500	86,500	9.5	18.2	0.9.12	Granular, 80 per cent; silky, 20 per cent.
757-9	Cap square	.505	.20	46,500	86,500	21.5	27.4	21.22*	Silky
787-5X	Gun lever	.505	.20	26,000	63,000	28.5	37.1	34.23	do.
790-5X	Cap square	.505	.20	40,100	78,000	20.5	34.0	23.28*	do.
792-2X	do	.505	.20	31,800	69,750	23.5	37.1	31.16	do.
801-3	Racer	.505	.20	39,500	67,900	29.5	43.3	30.28*	do.
808-2	Spur gear	.505	.20	27,000	70,500	27.0	37.1	35.19	do.
808-3	do	.505	.20	31,000	72,000	26.0	37.1	31.19	do.
810-08	Platform bracket	.505	.20	27,000	68,500	29.0	43.3	26.33*	do.
810-4	Spur gear	.505	.20	25,500	66,000	28.5	43.3	26.33*	Silky, 80 per cent; granular, 20 per cent.
810-5	do	.505	.20	36,000	74,000	19.0	20.5	21.17	Silky, 40 per cent; granular, 60 per cent.
816-01	do	.505	.20	30,000	71,500	28.0	37.1	27.29*	Silky, 50 per cent; granular, 50 per cent.
816-01	Platform bracket	.505	.20	28,000	70,500	27.5	37.1	22.32*	Silky, 70 per cent; granular, 30 per cent.
785-2X	Cap square	.505	.20	39,500	65,200	29.5	46.2	21.39*	Silky
785-2X	do	.505	.20	38,000	79,500	26.0	34.0	19.31*	do.

789-6X	do	20	31,000	68,000	29.0	43.3	28.30*	Do.
793-2X	do	20	30,500	65,500	28.5	37.1	27.30*	Do.
801-1	Racer	20	29,500	61,000	19.5	18.21*	18.21*	Granular, in part silky.
802-4	Buffer bracket	20	41,000	74,500	21.0	84.0	14.28*	Silky
809-8B	Cage	20	35,500	73,000	19.0	20.5	22* 16	Do.
810-2	Platform bracket	20	24,500	70,000	27.5	34.0	23.18 22*	Do.
813-3	Motor bracket	20	48,000	85,500	20.0	28.9	18.22*	Granular, 55 per cent; silky, 45 per cent.
818-3	Pedestal	20	38,500	81,000	22.0	27.4	20.24*	Silky
788-6X	do	20	38,500	79,000	16.0	20.5	19* 13	Do.
789-8X	do	20	45,500	80,000	20.5	20.5	20.21*	Do.
808-5	Motor bracket	20	41,500	90,500	15.0	16.9	16* 14	Granular; silky spot.
808-6	do	20	41,500	82,700	22.0	23.9	25* 19	Silky
809-1	do	20	46,000	86,500	9.0	13.2	08.10*	Granular; silky spot.
813-2	do	20	46,500	83,400	18.5	27.4	15.22*	Silky
819-0	Cap square	20	31,000	73,000	26.5	34.0	20.30*	Silky; trace of granulation.
780-4X	Cradle	20	49,800	95,100	11.0	13.2	10.12*	Granular; silky spot.
783-2	Racer clip	20	34,500	82,300	22.0	27.4	28* 21	Do.
800-1X	Cradle	20	42,000	84,100	20.0	20.5	19.21*	Do.
800-2X	do	20	32,500	73,600	17.5	20.5	13.22*	Do.
802-1	Racer clip	20	29,500	72,000	29.0	40.3	31* 29*	Granular.
807-1X	Cradle	20	39,000	84,400	14.0	20.5	18* 10	Silky
807-2X	do	20	36,500	80,500	15.0	16.9	18* 12	Granular; silky spot.
811-1X	do	20	36,000	72,900	27.5	34.0	31* 24	Do.
811-2X	do	20	32,000	71,000	25.0	27.4	32* 18	Do.
815-1X	do	20	53,000	78,000	17.5	17.5	15.20*	Granular, 40 per cent; silky, 60 per cent.
815-2X	do	20	53,000	76,500	25.0	27.4	28* 22	Do.
815-3X	do	20	34,000	76,500	25.0	27.4	28* 22	Do.
820-1X	do	20	38,000	83,000	15.0	16.9	15.15*	Granular, 80 per cent; silky, 70 per cent.
820-2X	do	20	39,500	82,000	15.0	16.9	15.15*	Granular.
691-06	do	20	44,500	83,700	14.5	20.5	11.13*	Silky.
691-08	do	20	42,000	82,000	12.0	16.9	11.13*	Dull silky; irregular.
780-3X	Cradle	20	56,500	94,000	9.0	9.5	11* 07	Granular, 70 per cent; silky, 80 per cent.
809-1B	Cage	20	36,500	71,000	10.5	13.2	12* 09	Granular.
794-1	Elevating arm	20	36,000	69,000	30.0	46.2	28.37*	Silky.
819-1X	Pivot yoke	20	44,500	81,500	12.5	16.9	10.15*	Granular, 60 per cent; silky, 40 per cent.
822-2X	do	20	41,500	77,600	25.0	34.0	21.29*	Silky.
822-3X	do	20	29,500	67,900	21.5	23.9	19.24*	Granular; silky spot.
824-1X	do	20	31,000	75,500	17.5	20.5	19* 16	Do.
824-2X	do	20	34,000	77,500	14.5	16.9	14.15*	Granular.
819-2X	do	20	37,000	77,000	18.5	20.5	22* 15	Granular, 50 per cent; silky, 50 per cent.
757-10	Gun lever	20	28,500	64,900	30.0	48.8	23.37*	Silky.
757-11	do	20	30,500	62,500	26.5	34.0	29* 22	Silky; trace of granulation.
802-5	Gun lever yoke	20	34,000	68,100	8.5	13.2	08.09*	Granular; silky spot.
825-01	Platform bracket	20	28,500	67,500	29.5	37.1	24.35*	Silky.
791-4	Elevating arm	20	36,000	75,600	23.5	30.7	19.29*	Silky; in part granular.
801-01	Platform bracket	20	36,000	75,600	26.0	27.4	20* 21	Silky; trace of granulation.
801-2X	do	20	26,500	67,000	21.5	20.5	20* 22	Granular.
801-3X	do	20	31,500	76,100	26.0	27.4	31* 19	Silky.
802-3	Buffer bracket	20	33,500	74,800	23.5	27.4	21.26*	Silky; interspersed with fine granulation.
808-7	do	20	30,500	70,100	23.0	23.9	20.24*	Granular; silky spot.
822-1X	Pivot yoke	20	42,000	77,500	22.5	23.9	18.27*	Do.
784-2	Elevating arm	20	38,000	70,500	21.5	30.7	30* 12	Do.
786-7X	Cap square	20	40,000	67,500	26.0	34.0	23.29*	Do.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Mark on specimens.	Description.	Diam. eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Inch.	Sq. inch.	Pounds.	Pounds.	Per cent.	Per cent.	"	
790-7X	Cap square.....	.505		41,500	70,000	21.5	27.4	.20, .25*	Silky.
792-3X	.....do	.505	.20	32,000	65,500	24.5	34.0	.32*, .17	Do.
795-3X	.....do	.505	.20	31,000	67,500	24.5	37.1	.32*, .21	Do.
801-5	Racer.....	.505	.20	36,000	71,500	25.0	34.0	.31*, .19	Silky; in part granular.
804-15	Deck circle.....	.505	.20	39,500	83,000	20.0	23.9	.22*, .15	Granular, 80 per cent; silky, 20 per cent.
807-15	.....do	.505	.20	47,000	85,000	18.5	20.5	.20*, .11	Granular; silky spot.
819-2Z	Cap square.....	.505	.20	37,000	80,300	18.5	27.4	.20*, .17	Granular, 60 per cent; silky, 40 per cent.
820-4X	Cradle.....	.505	.20	38,500	82,500	19.5	30.5	.22*, .09	Do.
823-7X	.....do	.505	.20	35,500	79,000	19.5	30.5	.18*, .19	Do.
781-C	Elevating arm.....	.505	.20	33,000	71,500	25.0	37.1	.31*, .15	Granular; silky spot.
805	Racer.....	.505	.20	34,500	73,000	25.0	37.1	.31*, .15	Silky; trace of granulation.
805-8	Motor bracket.....	.505	.20	34,500	73,000	25.0	37.1	.31*, .15	Silky.
805-9	Spur gear.....	.505	.20	35,500	75,000	25.5	37.4	.32*, .07*	Do.
809-1	Return spur gear.....	.505	.20	34,500	70,500	21.5	34.0	.28*, .15	Do.
809-1	Motor bracket.....	.505	.20	34,500	70,500	21.5	37.4	.28*, .15	Do.
745-05	Pedestal.....	.505	.20	40,500	77,100	21.5	27.4	.18, .25*	Do.
789-3Y	Pedestal.....	.505	.20	34,000	74,000	14.5	27.4	.14, .25*	Do.
789-10X	.....do	.505	.20	41,500	85,200	18.5	16.9	.15, .15*	Granular; silky spot.
791-5	Elevating arm.....	.505	.20	37,500	77,000	19.0	30.5	.22*, .15	Silky, 60 per cent; granular, 40 per cent.
801-7	Race.....	.505	.20	29,300	67,000	25.5	30.5	.18, .20*	Silky, 40 per cent; granular, 60 per cent.
811-3Y	Pedestal.....	.505	.20	34,500	70,500	25.5	40.3	.23, .28*	Silky, 60 per cent; granular, 40 per cent.
817-4X	.....do	.505	.20	29,000	69,300	28.5	30.7	.32*, .21	Silky.
827-1X	.....do	.505	.20	29,000	69,300	28.5	43.3	.35*, .24	Do.
827-2X	.....do	.505	.20	44,000	71,500	16.5	23.9	.22*, .11	Do.
827-3X	.....do	.505	.20	33,500	71,400	28.0	34.0	.28*, .28*	Do.
839-2A	Pivot yoke.....	.505	.20	32,000	72,000	26.0	34.0	.20, .22*	Do.
839-2A	Recoil sleeve.....	.505	.20	39,000	75,500	16.5	27.4	.13, .20*	Do.
837-5X	Pivot yoke.....	.505	.20	36,500	83,000	15.5	16.9	.17*, .14	Granular.
837-4X	.....do	.505	.20	37,300	83,500	13.5	16.9	.14, .23*	Granular.
840-01	Cap square.....	.505	.20	32,500	76,500	18.5	20.5	.15*, .12	Granular; silky spot.
840-1X	Pivot yoke.....	.505	.20	34,500	81,000	19.5	30.7	.22*, .17	Granular and silky interspersed.
843-01	Cap square.....	.505	.20	32,000	75,100	25.0	23.9	.22, .28*	Silky; trace of granulation.
843-1X	Pivot yoke.....	.505	.20	36,800	79,000	20.0	23.9	.22*, .18	Silky, 60 per cent; granular, 40 per cent.
843-2X	.....do	.505	.20	34,000	77,500	15.0	16.9	.15, .15*	Granular.
844-1X	Platform bracket.....	.505	.20	33,500	67,700	21.0	27.4	.26*, .17	Granular.
851-1X	.....do	.505	.20	34,000	64,800	25.0	34.0	.20, .30*	Silky; oblique.
863-1	Racer clip.....	.505	.20	32,500	67,400	25.5	37.1	.53*, .24	Do.
827-4X	Pivot yoke.....	.505	.20	32,000	72,000	24.0	27.4	.28*, .23*	Silky, 50 per cent; granular, 50 per cent.
837-2X	.....do	.505	.20	36,000	82,100	11.0	18.2	.10, .12*	Granular.
839-1A	Recoil sleeve.....	.505	.20	37,500	76,000	19.6	27.4	.22*, .17	Silky.
839-1A	.....do	.505	.20	40,500	78,200	25.5	37.1	.32*, .19	Do.

822-3X	Pivot yoke	505	20	43 500	71 900	11 5	30 5	08 15*	Silky; sand spot.
822-7X	do	505	20	37 500	76 800	18 5	20 5	22* 15	Granular, 60 per cent; silky, 40 per cent.
824-4X	do	505	20	30 500	80 100	20 5	23 9	16 25*	Granular, 40 per cent; silky, 60 per cent.
840-2X	do	505	20	27 000	79 800	15 0	16 9	14 16*	Granular; silky spot.
746-04	Pedestal	505	20	57 000	77 800	24 0	34 0	19 24*	Silky
746-06	do	505	20	38 900	77 800	21 5	23 9	19 24*	Silky and granular metal interspersed.
746-06	do	505	20	38 500	81 000	19 0	20 5	20* 20*	Silky
824-3X	Pivot yoke	505	20	47 500	85 800	15 0	16 9	16* 14	Granular; silky spot.
708-2X	Pedestal	505	20	38 500	77 100	23 5	30 7	25* 22	Do.
816-0	Elevating arm	505	20	36 000	77 100	29 5	48 3	24 33*	Do.
816-1	Gun lever	505	20	31 500	67 000	27 5	40 3	21 33*	Do.
816-2	do	505	20	31 500	67 000	11 5	13 2	13* 10	Granular; silky spot.
882-1X	Pivot yoke	505	20	35 500	82 000	16 0	16 9	17* 15	Granular, 60 per cent; silky, 40 per cent.
768-1X	Pedestal	505	20	36 500	78 500	20 0	20 5	18 22*	Granular; silky spot.
794-3X	do	505	20	43 500	86 800	20 0	20 5	18 22*	Granular.
802-2	Gun lever	505	20	44 000	69 800	11 5	16 9	13* 10	Granular.
814-52	do	505	20	44 000	78 500	20 5	20 5	18 22*	Silky; oblique.
818-3	do	505	20	34 500	69 500	26 5	40 3	25 29*	Silky.
819-3X	Gun lever	505	20	34 500	75 500	16 5	16 9	16 17*	Granular; silky spot.
819-5X	do	505	20	34 000	77 100	21 0	27 4	16 26*	Silky, interspersed with fine granulation.
822-2X	do	505	20	33 000	73 600	25 5	30 7	18 27*	Silky; trace of granulation.
822-3X	do	505	20	32 500	73 000	22 5	30 7	18 27*	Granular.
845-1X	do	505	20	33 500	79 700	10 5	13 2	12* 09	Granular, 70 per cent; silky, 30 per cent.
845-2X	do	505	20	34 500	82 000	19 5	20 5	18 21*	Silky.
845-3X	do	505	20	36 000	79 000	21 5	27 4	23* 20	Granular; 60 per cent; silky, 40 per cent.
798-12X	Pedestal	507	20	34 500	80 500	23 0	30 7	26* 20	Granular; silky spot.
798-14X	do	505	20	41 500	86 000	17 0	20 5	13 21*	Granular.
798-17X	do	505	20	42 000	82 400	21 5	23 9	24* 19	Silky; trace of granulation.
807-3X	do	507	20	37 000	82 500	22 0	23 9	25* 19	Silky.
807-4X	do	505	20	37 000	88 500	21 5	27 4	28* 20	Do.
820-1	Drum shaft gear	505	20	34 500	67 000	18 0	23 9	14 22*	Do.
857-1X	Platform bracket	505	20	31 500	67 000	80 0	46 2	40* 20	Do.
857-2X	do	505	20	31 500	73 000	27 5	34 0	26 29*	Do.
862-01	Cap square	505	20	39 000	79 000	19 5	30 7	12 27*	Do.
811-10X	do	505	20	41 500	79 000	24 0	34 0	17 31*	Do.
882-2X	Cradle	505	20	39 500	87 000	13 0	16 9	15* 11	Granular, 55 per cent; silky, 45 per cent.
847-1X	Pivot yoke	505	20	33 000	76 100	17 5	20 5	19* 16	Granular, 60 per cent; silky, 40 per cent.
847-2X	do	505	20	33 500	75 500	17 0	20 5	15 13*	Silky; sand spot.
854-1X	Platform bracket	505	20	29 000	61 500	33 0	51 9	36* 30	Silky.
867-3X	do	505	20	31 500	66 000	28 5	40 3	36* 21	Do.
785-07	Cradle	506	20	34 500	71 000	18 0	20 5	22* 14	Do.
785-018	do	506	20	34 000	69 100	21 5	34 0	18 30*	Do.
888-1X	do	506	20	41 000	86 200	15 5	16 9	14 17*	Granular; silky spot.
852-1X	Pivot yoke	506	20	34 000	76 500	23 0	34 0	23* 23*	Silky.
862-2X	do	506	20	35 000	76 500	25 0	34 0	29* 24*	Do.
691-05	Cradle	374	11	40 910	81 130	12 0	18 2	12* 12	Silky, 60 per cent; granular, 40 per cent.
791-7	Elevating arm	505	20	47 300	81 130	9 5	12 5	11* 08*	Silky, 40 per cent; granular, 60 per cent.
854-3X	Pivot yoke	505	20	36 500	80 500	21 0	30 7	21 21*	Silky, 60 per cent; granular, 40 per cent.
869-5X	do	505	20	35 500	80 500	19 0	23 9	16 22*	Granular; silky spot.
862-1X	Platform bracket	505	20	40 500	78 000	6 0	9 5	07* 05	Granular.
862-4X	do	505	20	34 500	71 000	28 0	43 3	33* 23	Silky.
862-4X	do	505	20	27 000	68 000	30 0	49 1	18 42*	Do.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on specimens.	Description.	Diam-eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Inch.	Sq. inch.	Pounds.	Pounds.	Per cent.	Per cent.	" "	
863-2X	Pivot yoke.....	.505	.20	38,500	73,400	28.5	37.1	.22, .85*	Silky; trace of granulation.
868-1X	Platform bracket.....	.505	.20	37,000	74,000	23.0	34.0	.17, .29*	Granular, 50 per cent; silky, 50 per cent.
868-2X	do.....	.505	.20	37,000	72,000	26.0	46.2	.37*, .15	Silky.
873-1X	do.....	.505	.20	28,000	63,900	31.0	37.1	.29, .33*	Silky; oblique.
875-3X	do.....	.505	.20	31,000	69,100	29.0	43.3	.39*, .29*	Silky.
876-3X	do.....	.505	.20	28,000	67,500	30.5	46.2	.23, .38*	Do.
877-04	do.....	.505	.20	32,500	74,500	5.0	9.5	.08, .07*	Granular; oblique; seamy line.
882-2X	Pivot yoke.....	.505	.20	32,500	70,000	25.0	37.1	.34*, .16	Silky.
883-1X	Platform bracket.....	.505	.20	31,500	71,900	24.0	30.7	.19, .24*	Silky, 60 per cent; granular, 40 per cent.
886-3X	Pivot yoke.....	.505	.20	31,500	64,100	27.0	37.1	.23, .31*	Silky.
887-3X	Platform bracket.....	.505	.20	38,500	81,600	4.3	9.5	.06*, .08	Granular.
847-3X	Pivot yoke.....	.505	.20	30,500	72,000	30.0	20.6	.10*, .20	Do.
888-2X	do.....	.505	.20	36,000	80,500	23.5	23.9	.16, .23*	Silky, 60 per cent; granular, 40 per cent.
888-4X	do.....	.505	.20	28,000	66,500	27.5	34.0	.31*, .24	Silky.
824-6X	Platform bracket.....	.505	.20	36,500	80,300	13.5	23.9	.16, .23*	Silky; granular at circumference.
887-6X	Pedestal.....	.505	.20	36,500	82,000	20.5	27.4	.17, .24*	Silky, 50 per cent; granular, 50 per cent.
890-2X	Pivot yoke.....	.505	.20	32,000	74,000	27.0	30.5	.21, .31*	Granular.
890-3X	do.....	.505	.20	30,500	78,100	10.0	27.1	.23, .31*	Silky.
890-4X	do.....	.505	.20	30,500	81,000	11.5	20.5	.21*, .19*	Granular; in part silky.
899-2X	do.....	.505	.20	36,500	81,000	18.5	13.2	.17, .26*	Granular; in part spot.
899-3X	do.....	.505	.20	38,000	84,500	10.5	20.9	.11, .11*	Granular, 40 per cent; silky, 30 per cent.
899-4X	do.....	.505	.20	34,500	81,500	15.0	16.7	.17, .13	Granular; silky spot.
899-5X	do.....	.505	.20	34,500	84,500	15.0	18.7	.18, .18	Granular; in part silky.
899-6X	do.....	.505	.20	28,000	70,500	25.0	30.3	.35*, .18	Do.
872-2X	Cradle.....	.505	.20	28,000	68,100	28.0	40.3	.35*, .21	Silky.
874-1	do.....	.505	.20	26,500	66,900	28.0	40.3	.35*, .21	Do.
874-2	do.....	.505	.20	28,500	68,400	28.5	40.3	.39*, .21	Do.
875-06	Buffer bracket.....	.505	.20	51,000	95,100	14.0	23.5	.07*, .04	Granular; in part silky.
875-06	do.....	.505	.20	41,000	65,500	5.5	10*	.17*, .19*	Defective; broke in neck; silky; spongy.
837-5X	Pedestal.....	.505	.20	27,500	67,000	30.0	30.3	.25, .35*	Granular, 60 per cent; silky, 40 per cent.
841-1X	Cradle.....	.505	.20	41,000	85,100	14.0	20.5	.07*, .04	Silky.
841-2X	do.....	.505	.20	41,000	85,100	14.0	20.5	.07*, .04	Granular; silky spot.
875-05	Platform bracket.....	.505	.20	27,500	67,000	30.0	30.3	.25, .35*	Do.
800-1X	do.....	.505	.20	44,000	78,900	15.0	16.9	.15*, .15	Silky.
811-6X	Cradle.....	.505	.20	44,000	78,900	15.0	16.9	.15*, .15	Granular; silky spot.
811-7X	do.....	.505	.20	48,500	80,500	23.0	30.7	.21, .26*	Silky.
811-8X	do.....	.505	.20	49,500	82,000	18.0	20.5	.15, .31*	Do.
845-3X	do.....	.505	.20	39,500	80,000	16.5	20.5	.18, .18, .23*	Silky; trace of granulation.
849-1	Ret. spur gear.....	.505	.20	38,000	76,700	20.5	20.5	.18, .23*	Granular; silky spot.
863-3X	Cradle.....	.505	.20	37,500	74,000	25.5	37.1	.33*, .28*	Granular; in part silky.
867-02	Pedestal.....	.505	.20	29,500	69,100	28.5	40.3	.24, .38*	Silky; trace of granulation.
872-1X	Cradle.....	.505	.20	33,500	77,000	21.5	23.9	.23*, .20	Granular; silky spot.
872-02	do.....	.505	.20	36,000	78,500	16.5	20.5	.19*, .14	Granular.

874-4	Motor bracket.....	505	37,500	67,000	32.0	46.2	23.41*	Silky.
874-5	Ret. spur gear.....	505	24,000	32,500	32.0	43.8	38*	Do.
875-01	Platform bracket.....	505	27,500	35,500	30.5	46.2	21.40*	Do.
877-1	Motor bracket.....	505	20,500	28,500	28.5	49.1	40*	Do.
879-02	Cradle.....	505	43,000	71,500	23.5	87.1	17.30*	Do.
880-01	Platform bracket.....	505	31,000	73,000	20.5	28.9	18.29*	Granular; silky spot.
880-02	do.....	505	31,000	74,000	25.0	30.7	21.29*	Do.
880-08	do.....	505	31,000	73,000	25.0	40.8	21.35*	Do.
887-01	Pedestal.....	505	20,000	82,000	20.0	23.9	23*	Granular, 60 per cent; silky, 40 per cent.
887-0X	Pivot yoke.....	505	39,500	80,100	20.0	23.9	14.15*	Granular; silky spot.
845-6X	Cradle.....	505	38,500	83,500	14.5	13.2	15*	Granular; in part silky.
863-4X	Cradle.....	505	39,500	74,000	20.0	23.9	21.37*	Silky.
867-01	Pedestal.....	505	20,000	62,000	21.5	80.7	16.27*	Granular; silky spot.
870-1X	Pivot yoke.....	505	29,000	73,100	21.5	23.9	23*	Granular.
870-2X	do.....	505	29,000	65,800	23.5	46.2	23.36*	Silky.
876-02	Platform bracket.....	505	20,000	75,500	30.0	40.3	84*	Do.
876-1X	Pivot yoke.....	505	32,500	76,000	23.5	27.4	23*	Granular; silky spot.
877-01	Motor bracket.....	505	27,000	65,600	30.0	46.2	40*	Silky.
877-2	do.....	505	28,000	65,500	23.0	46.2	33*	Do.
877-3	do.....	505	28,000	65,500	23.0	46.2	32*	Do.
879-04	Cradle.....	505	38,500	82,500	14.5	16.9	12.17*	Granular, 60 per cent; silky, 40 per cent.
882-1	Buffer bracket.....	505	35,500	70,500	25.5	40.3	15.86*	Silky.
791-2C	Elevating arm.....	507	36,000	81,000	19.5	27.4	19.27*	Granular; in part silky.
791-3C	do.....	507	36,000	77,500	25.0	27.4	19.27*	Silky and fine granular interspersed.
791-4C	do.....	505	38,000	77,500	25.0	37.1	25*	Silky.
800-3X	Cradle.....	505	42,500	81,000	16.5	16.9	15.18*	Do.
807-5X	Pedestal.....	505	41,500	80,000	13.5	16.9	16*	Do.
862-1	Elevating band.....	505	29,500	68,700	28.0	48.3	25.31*	Silky.
864-1	do.....	505	29,500	66,000	28.5	48.3	25.31*	Do.
864-2	do.....	505	31,000	67,000	26.0	40.3	20.35*	Do.
872-01	Cradle.....	505	30,500	75,500	26.0	80.7	25.27*	Granular; silky spot.
876-02	do.....	505	30,500	77,000	19.5	43.3	31*	Do.
879-01	do.....	505	32,500	72,000	27.0	43.3	31*	Silky.
824-7X	do.....	505	39,000	74,000	7.0	5.7	08*	Do.
824-9X	do.....	505	38,500	79,000	10.5	13.2	10.11	Granular; Irregular; silky spot.
847-5X	Pivot yoke.....	505	37,500	78,200	24.0	80.7	25*	Silky.
847-7X	do.....	505	31,000	73,200	21.0	23.9	20.22*	Granular.
847-8X	do.....	505	32,000	73,900	18.5	20.8	17.20*	Granular; in part silky.
847-9X	do.....	505	30,000	72,000	20.0	20.8	23*	Do.
847-10X	do.....	505	30,500	69,000	12.0	12.12	12.12	Granular.
866-1X	do.....	505	37,000	80,100	18.5	20.5	22*	Granular; silky spot.
866-2X	do.....	495	37,300	70,810	20.0	25.1	21*	Do.
869-10X	do.....	495	49,500	79,900	3.5	5.7	06*	Do.
866-01	Cap square.....	505	37,500	68,000	23.5	48.3	38*	Granular.
872-08	do.....	505	40,500	84,000	18.5	23.9	21*	Silky; Irregular; oblique.
877-4	Return spur gear.....	505	39,500	84,000	17.0	23.9	17.17*	Granular; silky spot.
878-2X	Cradle.....	505	43,000	85,600	22.0	20.5	19.17*	Granular, 70 per cent; silky, 30 per cent.
879-08	do.....	505	38,000	60,600	5.0	5.7	08.07	Granular; discolored spot at circuit.
883-2X	Distance ring.....	505	33,000	68,000	27.0	40.3	38*	Silky.
888-1X	Platform bracket.....	505	31,000	64,000	6.0	9.5	05*	Do.
888-2X	do.....	505	31,000	64,000	29.0	40.3	24.84*	Silky.
888-2X	do.....	505	31,300	70,500	23.0	37.1	33*	Do.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on specimens.	Description.	Diam-eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elonga-tion of 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
893-2	Racer clip	Inch. .505	28,000	57,500	31.5	46.2	46.2	.27, .36*	silky.
893-02	Platform bracket	.506	29,500	64,800	30.5	46.2	46.2	.37*, 24	Fine silky.
893-08	do	.506	27,500	63,500	30.5	46.2	46.2	.41*, 20	Do.
894-01	do	.505	33,000	71,300	29.0	48.8	48.8	.37*, 21	Do.
894-3X	do	.506	32,000	69,450	27.0	84.0	84.0	.38*, 21	Do.
791-8	Elevating arm	.505	36,000	77,400	21.0	77.4	77.4	.19, .23*	Granular; silky spot.
791-9	do	.506	35,500	77,400	24.0	80.7	80.7	.24*, 24*	Granular; in part silky.
841-5X	Cradle	.505	37,500	81,500	17.5	20.5	20.5	.20*, 15	Granular, 70 per cent; silky, 30 per cent.
847-12X	Pivot yoke	.505	33,000	75,000	13.5	16.9	16.9	.11, .16*	Granular, 70 per cent; silky, 30 per cent.
855-1	Spur gear	.505	29,000	61,500	31.0	40.8	40.8	.31*, 31*	Silky; irregular; sand spot.
859-3X	Pivot yoke	.505	38,500	82,500	11.0	18.2	18.2	.12*, 10	Granular; silky spot.
859-12X	do	.505	36,000	83,000	14.5	18.2	18.2	.14, .15*	Do.
859-14X	do	.505	38,000	84,700	18.0	20.5	20.5	.22*, 14	Do.
877-7	Elevating arm	.505	38,500	70,100	30.0	40.3	40.3	.28*, 32*	Silky.
878-1X	Pivot yoke	.505	43,500	82,500	14.5	20.6	20.6	.20*, 19	Granular, 60 per cent; silky, 40 per cent.
883-01	Platform bracket	.505	32,000	66,000	27.0	37.1	37.1	.36*, 18	Silky.
883-08	do	.505	29,500	66,200	25.8	34.0	34.0	.19, .32*	Do.
885-1	Ret. spur gear	.505	39,500	78,500	26.0	37.1	37.1	.21, 31*	Do.
886-1A	Pivot socket	.505	30,500	63,500	29.0	43.3	43.3	.23, .38*	Silky, 50 per cent; granular, 50 per cent.
886-0A	Platform bracket	.505	34,500	70,300	28.0	43.3	43.3	.22, 39*	Silky.
894-1X	do	.505	32,500	68,000	28.0	37.1	37.1	.33*, 25	Do.
895-1	Motor bracket	.505	35,500	80,100	19.8	20.5	20.5	.17, .22*	Granular; silky spot.
823-1A	Pivot yoke	.505	32,500	69,000	18.0	20.5	20.5	.16, .29*	Do.
837-7X	do	.505	38,000	81,900	12.5	13.2	13.2	.10, .13*	Do.
837-3X	do	.505	41,000	81,700	11.5	13.2	13.2	.10, .13*	Do.
841-3X	Cradle	.505	27,500	71,300	21.5	34.0	34.0	.30*, 11	Granular, 60 per cent; silky, 40 per cent.
872-1X	do	.505	31,000	73,500	17.5	23.9	23.9	.20*, 13	Granular.
872-3X	do	.505	34,500	66,500	31.5	43.3	43.3	.24, 34*	Silky.
873-2X	Platform bracket	.505	31,500	70,500	29.5	34.0	34.0	.32*, 21*	Silky; oblique.
877-6	Elevating arm	.505	31,500	67,800	33.0	43.3	43.3	.32*, 23	Do.
877-9	do	.505	31,500	70,800	33.0	43.3	43.3	.32*, 23	Do.
885-1X	Platform bracket	.505	35,000	64,000	30.0	46.2	46.2	.37*, 24	Do.
885-02	do	.506	35,000	64,000	30.0	46.2	46.2	.37*, 24	Do.
886-1X	do	.506	37,500	67,500	29.0	30.7	30.7	.37*, 18	Do.
886-3X	do	.506	37,500	67,500	29.0	30.7	30.7	.37*, 18	Do.
886-4X	do	.506	37,500	67,500	29.0	30.7	30.7	.37*, 18	Do.
886-01	do	.506	34,500	63,500	30.5	43.3	43.3	.26*, 25	Do.
894-1X	do	.506	34,500	69,000	30.5	43.3	43.3	.26*, 25	Do.
896-1	Motor bracket	.506	34,000	71,500	27.5	40.2	40.2	.30*, 26	Do.
896-2	Gun-lever yoke	.506	34,000	63,500	32.5	46.2	46.2	.30*, 26	Do.
887-3X	Pivot yoke	.506	39,000	87,400	13.5	13.2	13.2	.13*, 14	Granular; silky spot.

887-10Xdo	20	39,500	83,100	10.0	13.2	09, 11*
872-05	Cradle	20	74,300	15,5	15.5	14, 17*	
872-07	.....do	20	88,000	71,100	23.0	31, 15
886-2X	.....do	20	36,000	78,500	26.5	20, 31
887-2X	.....do	20	80,000	77,600	21.6	28*, 15
888-2X	Pivot yoke	20	87,000	77,200	24.6	28*, 15	
889-4X	Pedestal	20	82,500	76,500	37.1	28*, 26	
889-01	.....do	19	41,050	76,580	8.5	11*, 06
889-02	.....do	20	42,000	76,500	26.5	22, 31*
891-1X	Pivot yoke	20	34,500	73,000	26.0	30*, 23	
891-2X	.....do	20	30,500	73,500	26.6	30*, 23
892-1X	Cap-square	20	33,000	76,000	27.0	25, 29*	
897-2X	Pivot yoke	20	34,500	76,000	40.3	36*, 25	
898-1X	.....do	20	28,000	63,900	17.5	27*, 26*
898-2X	Cap-square	20	38,000	82,500	46.2	32*, 32*	
897-9X	.....do	20	37,000	80,600	24.0	20*, 15
897-3X	Pedestal	20	30,500	72,900	22.0	26*, 22	
870-3X	.....do	20	29,500	69,000	28.0	18, 26*
870-4X	Pivot yoke	20	29,000	69,000	43.3	21, 35*	
884-1X	.....do	20	29,000	73,600	23.5	30, 7
884-2X	.....do	20	32,000	67,000	8.0	11*, 06
887-5X	Cradle	20	41,500	79,000	26.0	20, 30*	
889-1X	Pivot yoke	20	34,500	76,500	23.0	32*, 14	
892-2X	.....do	20	39,000	76,000	23.0	29*, 17
892-3X	.....do	20	37,000	78,000	19.5	16*, 23*
894-1	Gun lever	20	30,500	68,500	31.5	26, 37*	
894-2	.....do	20	31,500	69,100	30.0	42*, 18
894-3	.....do	20	29,500	68,500	30.0	24, 35*
901-1X	Cap-square	20	31,500	77,000	23.0	22, 24*	
888-1	Racer	20	29,000	66,100	26.5	17, 36*	
888-2	.....do	20	26,500	67,000	31.0	40*, 22
888-3	.....do	20	26,500	66,000	28.0	38*, 14
886-4X	Pivot yoke	20	48,500	80,900	13.5	13, 2	
886-6X	.....do	20	37,500	77,800	16.5	13, 14*
889-3X	Pedestal	20	31,500	75,800	25.0	20*, 13	
890-02	Platform bracket	20	30,100	61,900	43*	21, 29*	
851-1A	Outer base	20	26,500	61,700	28.5	43*, 12	
884-3X	Cradle	20	36,000	71,600	17.0	17, 40*	
884-4X	.....do	20	36,000	78,100	21.0	19*, 15
885-3X	Platform bracket	20	36,000	76,500	27.5	22*, 18	
895-1	Elevating arm	20	31,500	71,500	26.0	37*, 18	
895-3	.....do	20	36,000	72,050	25.5	17, 33*
895-5	.....do	20	36,000	72,050	25.5	36*, 16
892-2X	Cradle	20	39,000	82,900	22.0	21, 23*	
896-3X	.....do	20	42,500	80,500	22.5	23*, 22*
896-4X	.....do	20	40,500	82,900	23.0	18, 26*
897-1X	.....do	20	41,900	82,500	17.0	23*, 11
897-2X	.....do	20	38,000	78,000	22.5	25*, 19
876-08	.....do	20	34,000	77,000	22.5	31*, 20
896-5X	.....do	20	37,500	71,200	23.5	30*, 17
888-2	Elevating band	20	32,500	78,100	30.7	31*, 20	
896-2	Elevating arm	20	34,000	72,050	46.2	19, 38*	
897-3X	Cradle	20	44,500	84,000	27.0	24, 32*	
Do.	Granular						
Granular; silky center.							
Silky.							
Granular, 70 per cent; silky, 30 per cent.							
Silky; trace of granulation.							
Do.							
Granular; in part silky.							
Silky.							
Do.							
Do.							
Do.							
Do.							
Do.							
Granular, 70 per cent; silky, 30 per cent.							
Granular, 50 per cent; silky, 50 per cent.							
Granular; in part silky.							
Silky.							
Granular.							
Granular; sand spot.							
Silky.							
Do.							
Silky; oblique.							
Granular; in part silky.							
Silky.							
Do.							
Do.							
Granular.							
Silky.							
Do.							
Do.							
Granular, 90 per cent; silky, 20 per cent.							
Granular; in part silky.							
Silky.							
Do.							
Granular, 70 per cent; silky, 30 per cent.							
Granular, 60 per cent; silky, 40 per cent.							
Silky.							
Do.							
Do.							
Do.							
Silky; granular metal interspersed.							
Silky.							
Do.							
Silky; in part granular.							
Do.							
Silky.							
Do.							
Do.							
Do.							
Do.							

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on specimens.	Description.	Diam-eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elonga-tion in 2 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Inch.	Sq. inch.	Pounds.	Pounds.	Per cent.	Per cent.	" "	
897-1X	Cradle	.506	.20	31,000	68,500	27.0	49.1	16, 38*	Silky.
898-5A	do	.507	.20	36,000	82,500	22.0	30.7	18, 26*	Silky; interspersed with fine granulation.
919-1A	Pivot yoke	.507	.20	36,000	82,500	21.5	34.0	16, 27*	Silky.
887-7A	Motor bracket	.505	.20	27,000	59,500	19.0	16.9	17, 21*	Granular, 55 per cent; silky, 45 per cent.
884-5X	do	.507	.20	27,000	78,000	17.5	16.9	19*, 16	Granular, 60 per cent; silky, 40 per cent.
884-7X	do	.506	.20	24,500	67,000	21.5	27.4	24*, 14*	Silky; trace of granulation.
892-3	Racer clip	.505	.20	31,500	57,000	29.0	40.5	16, 19	Do.
898-6X	Cap square	.505	.20	36,000	70,800	23.0	46.7	20*, 28*	Do.
901-2X	do	.505	.20	36,000	74,000	23.0	37.9	27*, 23*	Do.
901-3A	Pedestal	.506	.20	40,500	65,500	14.0	16.9	17*, 21*	Granular; silky spot.
823-2A	Pivot yoke	.502	.20	37,000	65,500	18.0	16.9	16*, 18	Do.
823-3A	do	.506	.20	36,500	82,400	19.0	15.5	17, 21*	Do.
884-8X	do	.507	.20	38,000	82,000	19.0	20.5	20*, 10	Granular, 70 per cent; silky, 30 per cent.
884-9X	do	.505	.20	44,000	85,800	17.5	23.9	18*, 17	Silky; trace of granulation.
884-10X	do	.507	.20	38,500	80,300	17.0	20.5	19, 20*	Granular; 70 per cent; silky, 30 per cent.
884-11X	do	.506	.20	46,000	85,500	18.0	23.9	22*, 13	Silky; in part granular.
884-12X	do	.507	.20	26,500	68,000	27.0	34.0	22*, 20	Granular; silky granular.
847-13X	do	.507	.20	27,000	68,500	30.0	40.3	83*, 27	Silky; in part granular.
876-3X	do	.506	.20	37,000	77,500	18.0	20.5	17, 19*	Granular, 60 per cent; silky, 40 per cent.
876-4X	do	.506	.20	32,000	74,500	22.5	27.4	17, 28*	Granular; silky spot.
879-05	Cradle	.506	.20	44,500	81,000	18.0	27.4	20*, 16	Silky.
879-06	do	.503	.20	32,500	69,000	22.0	43.3	37*, 24	Do.
886-3X	do	.506	.20	36,500	69,000	20.0	27.4	24*, 20	Granular and silky interspersed.
886-6X	do	.506	.20	36,500	76,500	20.0	36.8	12, 28*	Silky; trace of granulation.
886-7X	Pivot yoke	.486	.19	37,370	80,000	20.0	30.7	27*, 14	Granular; in part silky.
901-6X	Pedestal	.504	.20	37,000	78,200	20.5	20.5	19, 22*	Silky.
811-11X	do	.506	.20	37,000	79,500	20.5	37.1	22, 27*	Granular, 60 per cent; silky, 40 per cent.
811-12X	do	.506	.20	43,000	78,500	24.5	30.7	22, 27*	Granular, 70 per cent; silky, 30 per cent.
824-10X	Cradle	.506	.20	31,000	80,800	22.0	16.8	13*, 11	Granular, 50 per cent; silky, 50 per cent.
824-11X	do	.506	.20	42,000	81,100	20.0	20.5	22*, 18	Granular, 60 per cent; silky, 50 per cent.
833-4X	do	.506	.20	38,500	86,700	9.0	9.5	08, 10*	Granular; silky spot.
837-11X	Pivot yoke	.506	.20	34,500	67,000	8.0	9.5	07, 09*	Do.
837-12X	do	.506	.20	38,500	85,500	13.5	13.2	15*, 12	Do.
841-6X	do	.507	.20	38,000	81,600	13.0	13.2	13*, 13	Do.
841-7X	do	.507	.20	36,000	79,000	11.0	9.5	12*, 10	Do.
847-16X	Pivot yoke	.506	.20	39,500	75,500	14.5	20.5	13, 18*	Silky, 60 per cent; granular, 40 per cent.
847-17X	do	.506	.20	35,000	74,100	15.5	20.5	19*, 10	Silky; irregular surface.
856-7X	do	.507	.20	36,500	83,400	15.5	16.9	15, 16*	Granular; silky spot.
856-8X	do	.506	.20	40,500	84,000	14.0	16.9	16*, 12	Do.
856-9X	do	.506	.20	40,500	84,000	14.0	16.9	16*, 12	Do.
865-3X	do	.506	.20	32,000	77,000	22.5	27.4	25*, 20	Granular, 50 per cent; silky, 50 per cent.
865-4X	do	.506	.20	36,000	77,000	23.0	27.4	25*, 21	Do.
867-08	Pedestal	.506	.20	38,500	80,100	27.5	37.1	25, 26, 29*	Silky.

867-04	do	566	32,000	74,500	26.5	87.1	31*	Silky; trace of granulation.
867-4X	Cradle	567	38,500	77,900	23.5	30.7	16, 31*	Do.
867-6X	do	568	39,500	78,500	19.0	20.5	16, 20*	Granular, 55 per cent; silky, 45 per cent.
870-5X	Pivot yoke	569	36,000	76,000	18.0	20.5	21*	Granular, 60 per cent; silky, 40 per cent.
870-6X	do	569	37,000	80,000	21.0	27.4	25*	Silky; trace of granulation.
876-3X	do	569	39,000	82,500	18.5	20.5	22*, 16	Granular, 60 per cent; silky, 40 per cent.
876-4X	do	569	31,500	77,000	23.0	23.9	28*	Granular; silky spot.
879-07	Cradle	569	31,500	77,000	24.5	34.0	28*	Silky.
879-08	do	569	39,000	76,000	27.0	40.3	28*	Do.
887-6X	Pivot yoke	569	37,000	71,500	9.0	9.5	31*	Dull alkly; trace of granulation.
887-7X	do	569	39,500	79,500	23.5	30.7	29*	Silky.
887-6X	Cradle	569	48,000	86,000	17.0	20.5	21*, 13	Silky, 60 per cent; granular, 40 per cent.
887-6X	do	569	47,000	78,500	7.0	9.5	06, 09*	Silky; smooth, lustrous spot.
901-5X	Pedestal	569	36,000	81,000	15.5	16.9	15*, 16*	Granular, 60 per cent; silky, 40 per cent.
901-7X	do	569	34,500	77,000	9.0	9.5	06, 10*	Granular.
919-01	Cradle	569	39,000	76,500	27.0	37.1	20, 34*	Do.
919-02	do	569	31,000	72,500	26.5	37.1	35*, 13	Granular; silky spot.
887-13X	Pedestal	569	39,000	84,500	10.0	9.5	09, 11*	Granular, 50 per cent; silky, 50 per cent.
870-7X	Pivot yoke	569	38,500	75,500	24.0	27.4	22, 26*	Granular, 50 per cent; smooth, lustrous, 50 per cent.
870-9X	do	569	29,500	61,000	3.5	5.7	07*, 00	Silky, 60 per cent; granular, 40 per cent.
872-7X	Cradle	569	40,000	78,500	17.5	20.5	19*, 16	Silky, 60 per cent; granular, 40 per cent.
872-8X	do	569	38,500	62,700	3.5	1.8	08, 04*	Granular; silky.
887-9X	do	569	37,000	78,000	25.0	34.0	22, 28*	Silky.
887-10X	do	569	36,000	77,000	25.5	40.3	33*, 13	Do.
884-12X	do	569	35,500	45,500	0.5	0.5	00, 01*	Broke in head. Dark granular and amorphous.
883-3X	do	569	42,000	87,000	15.5	16.9	18*, 13	Granular; silky spot.
841-8X	do	569	48,000	82,000	18.0	16.9	20*, 16	Granular, 50 per cent; silky, 50 per cent.
841-9X	do	569	38,000	81,000	10.5	9.5	12*, 09	Granular; silky spot.
845-6X	Pivot yoke	569	40,500	81,500	20.5	23.9	17, 24*	Granular; in part silky.
845-7X	do	569	42,500	79,500	13.0	13.2	15*, 11	Granular; silky spot.
859-7X	do	569	42,500	83,000	15.0	13.2	13, 17*	Do.
868-16X	Pivot yoke	569	41,000	84,000	18.0	16.9	19*, 18	Do.
868-16X	do	569	35,000	82,500	19.5	20.5	21*, 18	Silky; in part granular.
868-17X	do	569	37,000	84,200	16.0	16.9	15, 17*	Granular, 60 per cent; silky, 40 per cent.
868-18X	do	569	42,000	84,200	18.5	20.5	21*	Granular; silky spot.
868-20X	do	569	30,500	72,500	16.5	13.2	18*, 15	Granular, 70 per cent; silky, 30 per cent.
868-21X	Cradle	569	30,500	72,500	27.5	27.4	22, 31*	Granular; in part silky.
868-22X	Pivot yoke	569	30,000	61,500	15.5	15.5	31*, 24	Silky; trace of granulation.
872-6X	do	569	31,500	61,500	15.5	20.5	19*, 19	Granular; silky spot.
872-8X	do	569	31,500	61,500	24.5	34.0	32*, 17	Silky; in part granular.
882-2X	do	569	37,000	83,500	18.0	20.8	15, 21*	Granular; silky spot.
887-0X	do	569	24,500	68,000	12.0	13.2	10, 14*	Do.
887-08	Pedestal	569	24,500	68,000	31.5	46.5	35*, 25	Silky.
887-9X	do	569	24,500	67,000	31.5	46.5	35*, 25	Do.
887-10X	Pivot yoke	569	28,500	73,000	27.5	30.7	31*, 24	Granular; silky spot.
889-07	do	569	35,500	79,000	22.5	27.4	27*, 19	Silky, 60 per cent; granular, 40 per cent.
889-07	Pedestal	569	32,500	71,500	21.0	22.8	22*, 13	Silky; trace of granulation.
889-09	do	569	32,500	71,500	17.5	9.5	09, 13*	Granular; silky spot.
889-09	do	569	42,000	79,000	94.5	97.1	07*, 08	Do.
819-04	Cradle	569	24,500	71,500	25.0	37.1	24, 25	Silky; trace of granulation.
854-01	Platform bracket	569	34,500	71,000	25.0	27.1	24, 25	Granular, 60 per cent; silky, 40 per cent.
854-02	do	569	32,500	71,000	28.0	37.1	33*, 21	Silky; trace of granulation.
854-03	do	569	33,000	71,500	25.5	34.0	21*, 32*	Do.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

Marks on speci- mens.	Description.	Diam- eter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elonga- tion in 2 inches.	Contri- bution of area.	Contri- bution of sections.	Appearance of fracture.
		Inch.	Sq. inch.	Pounds.	Pounds.	Per cent.	Per cent.	" "	
964-04	Platform bracket.....	.506	.20	32,000	72,500	24.0	84.0	"	Silky.
964-05	do.....	.506	.20	32,000	71,000	27.0	84.0	30* 18	Do.
964-06	do.....	.506	.20	33,000	72,000	26.0	84.0	30* 24	Silky; trace of granulation.
964-07	do.....	.506	.20	33,500	71,800	15.5	20.5	18* 13	Do.
965-01	do.....	.506	.20	33,000	67,600	22.0	34.0	30* 14	Silky.
967-01	Cradle.....	.505	.20	48,000	81,200	13.0	23.9	15 21*	Silky; trace of granulation.
967-02	do.....	.505	.20	47,500	81,100	15.0	23.9	19* 11	Silky.
841-10X	do.....	.506	.20	41,000	86,300	16.5	16.9	18 20*	Granular; 70 per cent; silky, 80 per cent.
845-9X	Pivot yoke.....	.505	.20	41,000	78,000	9.0	9.5	08 10*	Granular.
869-22X	Cradle.....	.507	.20	43,600	85,750	10.5	9.5	12* 09	Granular; silky spot.
865-9X	Pivot yoke.....	.506	.20	39,500	82,650	10.5	13.2	08 13*	Granular; irregular.
867-09	Pedestal.....	.506	.20	39,500	82,650	18.0	23.9	24* 12	Silky.
897-11X	Cradle.....	.506	.20	37,500	79,000	24.0	30.7	19 31*	Do.
919-08	do.....	.506	.20	38,500	86,300	20.0	27.4	24* 16	Do.
901-9X	Pedestal.....	.507	.20	36,400	81,650	19.0	23.9	20* 18	Silky; 60 per cent; granular, 40 per cent.
811-13X	do.....	.506	.20	42,000	80,600	26.0	40.3	33* 17	Silky.
811-14X	do.....	.507	.20	46,000	81,100	19.5	27.4	23* 16	Do.
883-5X	Cradle.....	.506	.20	43,500	84,750	8.0	9.5	09* 07	Granular.
883-6X	do.....	.507	.20	40,500	88,900	13.0	13.2	11* 15*	Granular; silky spot.
841-11X	do.....	.441	.15	42,670	86,530	11.6	12.0	10* 13*	Do.
845-8X	Pivot yoke.....	.507	.20	39,500	84,750	13.5	13.2	15* 12	Granular.
865-8X	do.....	.506	.20	42,000	86,850	21.5	28.9	16 27*	Silky.
870-9X	do.....	.506	.20	34,850	74,850	12.5	13.2	11 14*	Granular.
870-10X	do.....	.507	.20	39,000	82,700	24.0	34.0	30* 18	Silky.
876-5X	do.....	.506	.20	38,500	83,700	21.5	30.7	26* 17	Do.
876-6X	do.....	.507	.20	42,500	85,800	22.0	40.8	32* 12	Do.
878-9X	do.....	.506	.20	44,000	91,000	13.5	16.9	11 13*	Do.
879-10X	do.....	.506	.20	45,750	88,400	13.5	16.9	11 13*	Do.
879-09	Cradle.....	.506	.20	44,700	88,200	15.0	23.9	11 19*	Do.
879-010	do.....	.507	.20	42,000	83,700	18.0	23.9	20* 16	Do.
897-12X	do.....	.505	.20	39,500	79,000	22.0	27.4	19 25*	Do.
919-07	do.....	.507	.20	42,500	87,850	13.0	13.2	14 22*	Silky; 50 per cent; granular, 50 per cent.
965-1A	Pedestal.....	.506	.20	34,300	75,400	17.5	16.9	15 20*	Silky; 40 per cent; granular, 60 per cent.
965-2A	do.....	.506	.20	36,400	75,400	22.0	23.9	19 23*	Silky.
965-3A	do.....	.507	.20	33,250	74,850	19.5	23.9	18 21*	Silky; 50 per cent; granular, 50 per cent.
965-4A	do.....	.507	.20	36,400	75,400	22.5	27.4	22* 23	Silky.
901-6X	do.....	.506	.20	42,500	81,100	19.5	27.4	21* 18*	Do.
867-010	do.....	.506	.20	48,000	82,650	17.5	23.9	22* 13	Do.
872-08	Cradle.....	.506	.20	43,500	81,000	19.0	20.5	21* 17	Do.
872-09	do.....	.506	.20	40,000	81,100	17.5	23.9	16 19*	Do.

STEEL CASTINGS FOR GUN CARRIAGES AND MOUNTS—Continued.

CHEMICAL ANALYSES.

Marks.	Carbon.	Manga- nese.	Silicon.	Sulphur.	Phos- phorus.
793-1.....	.58	.68	.24	.076	.041
668-11X.....	.26	.78	.82	.074	.040
790-2X.....	.31	.56	.16	.077	.060

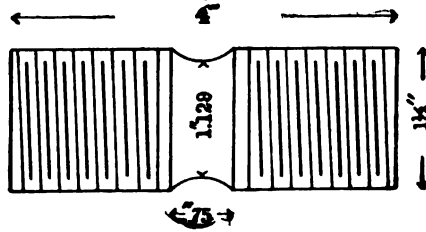
6-INCH BARBETTE GUN CARRIAGES.
 TENSILE TESTS OF STEEL SPECIMENS, FROM BUILDERS IRON FOUNDRY.
 FORGED STEEL.

No. of test.	Mark on specimen.	Diam-eter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.		Diameter at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
				Total.	Per square inch.	Total.	Per square inch.	Inch.	Per cent.				
10565	1	.505	.20	Pounds, 9,100	Pounds, 45,500	Pounds, 19,900	Pounds, 99,500	.50	95.0	.40	37.6	Granular; dull silky center	19.81*
10566	1	.505	.20	Pounds, 6,800	Pounds, 34,500	Pounds, 11,900	Pounds, 59,500	.78	89.0	.30	64.6	Silky	.50*, .28
10568	2	.505	.20	Pounds, 9,800	Pounds, 48,500	Pounds, 15,540	Pounds, 77,700	.45	22.5	.38	40.8	Fine silky	.22*, .28*
	5	.505	.20	Pounds, 12,200	Pounds, 61,000	Pounds, 15,520	Pounds, 77,600	.47	23.5	.35	51.9	do	.18, .24*
	6	.505	.20	Pounds, 12,800	Pounds, 61,500	Pounds, 15,600	Pounds, 78,000	.47	23.5	.35	51.9	do	.34*, .13

TENSILE TESTS OF STEEL SPECIMENS FROM BOSTON FORGE COMPANY.
FORGED STEEL.

No. of test.	Mark on specimen.	Diam-eter.	Sec-ondal area.	Elastic limit.		Tensile strength.		Elongation.		Diameter at frac-ture.	Contra-ction of area.	Appearance of fracture.	Elongation of Inch sections.			
				Total.	Per square inch.	Total.	Per square inch.	Inch.	Per ct.				"	"	"	
10671	7	.564	14,800	59,200	Pounds.	23,400	383,600	.90	22.5	.42	44.6	Silky	14.	18.	20.	
	8	.564	14,100	56,400	Pounds.	24,600	396,400	.65	21.7	.42	44.6	do	14.	18.	20.	
	9	.565	9,800	46,500	Pounds.	18,470	323,350	.67	23.5	.40	37.1	do	30*	17	15	
	10	.565	9,900	49,500	Pounds.	18,380	319,900	.50	25.0	.39	40.3	do	35*	15	20	
	11	.566	9,100	45,500	Pounds.	17,500	317,500	.55	27.5	.37	46.2	do	36*	20	30*	
	12	.565	10,700	53,500	Pounds.	17,640	385,200	.52	26.0	.36	49.1	do	19.	33*	20	
	13	.566	10,900	54,500	Pounds.	17,700	385,500	.54	27.0	.40	37.1	do	24*	30*	24*	
	14	.568	11,100	56,500	Pounds.	17,600	385,000	.54	27.0	.37	46.2	do	36*	18	25*	
	15	.563	9,300	46,500	Pounds.	20,200	101,000	.38	19.0	.42	30.7	Silky, trace of granulation	do	12.	12.	25*
	16	.563	9,800	49,900	Pounds.	19,920	99,600	.38	19.0	.42	30.7	Granular, silky center	do	11.	11.	27*
	17	.565	10,200	51,000	Pounds.	21,100	105,500	.35	17.5	.43	27.4	Silky, trace of granulation at circum-ference.	do	11.	24*	26*
	18	.565	9,540	47,700	Pounds.	19,400	97,000	.39	19.5	.42	30.7	do	do	13.	13.	26*
10668	19	.563	9,020	45,100	Pounds.	19,380	96,900	.37	18.5	.42	30.7	do	12.	25*	19	
	20	.562	9,720	48,600	Pounds.	19,860	99,300	.41	20.5	.41	34.0	do	do	22*	19	
	21	.563	9,760	48,800	Pounds.	20,600	103,000	.38	19.0	.42	30.7	do	do	12.	26*	12
	22	.565	7,940	39,700	Pounds.	17,900	89,500	.38	19.0	.41	34.0	Silky, trace of granulation	do	26*	12	26*
	23	.568	8,700	43,500	Pounds.	19,800	99,000	.32	16.0	.42	30.7	Granular, silky center	do	22*	10	22*
	24	.566	8,800	44,500	Pounds.	18,600	93,000	.36	18.0	.41	34.0	Silky	do	10.	26*	13
	25	.568	8,500	44,000	Pounds.	18,400	92,000	.39	19.5	.41	34.0	Silky, interspersed with fine granulation.	do	10.	26*	13
	26	.568	7,100	40,500	Pounds.	17,500	87,500	.38	19.0	.41	34.0	Silky, trace of granulation	do	12.	26*	13
	27	.568	7,740	38,700	Pounds.	17,740	88,700	.46	23.0	.38	37.1	Fine silky	do	14.	32*	11
	28	.565	10,400	52,000	Pounds.	19,740	98,700	.46	23.0	.38	43.3	do	do	17.	31*	18
	29	.565	11,000	57,500	Pounds.	19,680	98,400	.46	22.5	.38	43.3	do	do	15.	32*	15
	30	.565	11,800	62,500	Pounds.	23,400	117,000	.30	15.0	.46	16.9	Granular, silky spot at circumference	do	14*	16*	10*
None.	None.	.562	14,400	72,000	Pounds.	19,020	95,100	.22	11.0	.46	9.5	Fine granular, radiating from center	do	12*	10*	12*
10666	None.	.505	14,800	71,500	Pounds.	19,800	99,000	.25	12.5	.46	16.9	do	19*	13*	13*	
	*	.505	11,400	57,000	Pounds.	18,360	91,800	.34	17.0	.42	30.7	Silky, interspersed with fine granulation.	do	22*	12	22*
10698	11A	.605	11,960	59,900	Pounds.	19,080	95,800	.53	26.5	.37	46.2	Silky	86*	17	24*	
	12A	.605	11,800	59,500	Pounds.	18,400	92,000	.54	27.0	.36	49.1	do	30*	15	24*	
	13A	.605	11,800	59,500	Pounds.	18,400	92,000	.51	25.5	.36	49.1	do	31*	15	24*	
	14A	.605	11,020	56,100	Pounds.	18,500	92,500	.47	26.0	.36	49.1	do	31*	15	24*	
	28	.605	11,100	56,500	Pounds.	19,800	94,000	.47	23.5	.38	43.3	do	26*	21	21*	
	29	.605	10,920	54,600	Pounds.	19,650	93,250	.47	23.5	.38	43.3	do	15.	33*	15	

TENSION TESTS OF CAST IRON FROM WATERTOWN ARSENAL FOUNDRY.



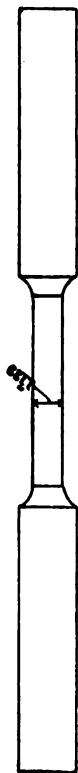
No. of test.	Description.	Tensile strength per square inch.	Fracture.	Specific gravity.
		<i>Pounds.</i>		
6794	75-millimeter shell	25,800	Fine granular, gray	7.021
6800	do	20,600	do	7.370
6827	3-inch shell	24,000	Granular, gray	7.321
6828	do	25,600	do	
6880	do	29,700	do	
6842	do	28,700	Fine granular, gray	7.224
6844	do	22,300	do	
6850	do	26,600	do	
6852	do	28,000	do	
6854	do	27,900	do	
6866	do	21,060	do	
6867	do	26,400	do	
6869	do	25,600	do	
6843	10-inch shot	30,400	do	7.185
6845	do	33,700	do	
6848	do	34,100	do	
6851	do	28,800	do	
6853	do	34,200	do	
6855	do	27,400	do	
6868	do	35,300	do	
6791	12-inch mortar shell	30,200	do	7.204
6799	do	28,800	do	7.200
6801	do	30,400	do	7.198
6803	do	26,350	do	7.118
6834	do	32,200	do	7.211
6835	do	29,800	do	7.227
6840	do	29,000	do	7.177
6836	12-inch mortar shot	31,900	do	7.266
6837	do	28,800	do	7.176
6838	do	34,400	do	7.156
6839	do	30,900	do	7.239
6840	do	29,000	do	7.177
6860	do	35,800	do	
6861	do	32,500	Fine granular, light gray	
6863	do	31,500	Fine granular, gray	
6870	do	28,500	do	
6782	16-inch shot	29,590	do	7.223
6783	do	29,180	do	7.061
6786	do	30,900	Fine granular, light gray	7.222
6787	do	31,800	Fine granular, gray	
6788	do	30,900	do	
6792	do	29,150	do	7.223
6793	do	32,980	Fine granular, light gray	7.226
6798	do	29,100	Fine granular, gray	7.191
6801	do	30,400	do	7.193
6803	do	25,350	do	7.118
6804	do	27,100	do	7.195
6806	do	35,200	Fine granular, light gray	7.280
6807	do	35,900	do	7.319
6809	do	35,300	do	7.212
6810	do	35,200	do	7.208
6813	do	34,900	do	7.228
6814	do	32,500	do	7.181
6818	10-inch disappearing carriage, top carriage.	33,200	Fine granular, gray	7.270
6825	do	32,100	Granular, gray	7.228
6832	do	33,200	Fine granular, gray	7.263
6837	do	28,800	do	7.176
6857	do	30,050	Granular, gray	
6358	10-inch disappearing carriage, chassis.	30,200	Fine granular, gray	

TENSION TESTS OF CAST IRON FROM WATERTOWN ARSENAL FOUNDRY—
Continued.

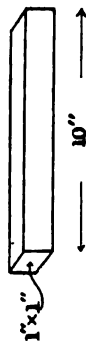
No. of test.	Description.	Tensile strength per square inch.	Fracture.	Specific gravity.
6859	10-inch disappearing carriage, chassis.	<i>Pounds.</i> 29,400	Fine granular, gray	
6862	.....do.....	28,900	.....do.....	
6865	.....do.....	29,800	.....do.....	
6796	10-inch disappearing carriage base ring.	31,420	.....do.....	7.202
6806	.....do.....	35,200	Fine granular, light gray.....	7.280
6815	.....do.....	36,100	.....do.....	7.222
6821	.....do.....	28,800	Fine granular, gray. Blowhole at cir.	7.150
6823	.....do.....	27,400	Fine granular, gray.....	7.237
6833	.....do.....	30,900	.....do.....	7.277
6841	.....do.....	29,600	.....do.....	7.154
6783	12-inch disappearing carriage base ring.	29,180	.....do.....	7.081
6799	.....do.....	28,800	.....do.....	7.200
MISCELLANEOUS.				
6829	From Builders Iron Foundry, marks T C T D 7. From C. H. Cowdrey Machine Co.:	22,100	Fine granular, gray.....	
6826	Marks G	28,500	Granular, gray.....	
6846	Marks A 11	27,300	Fine granular, light gray.....	
6847	Marks A A	25,200	.....do.....	

ANCHOR BOLTS FOR GUN CARRIAGES.

TENSION SPECIMENS.



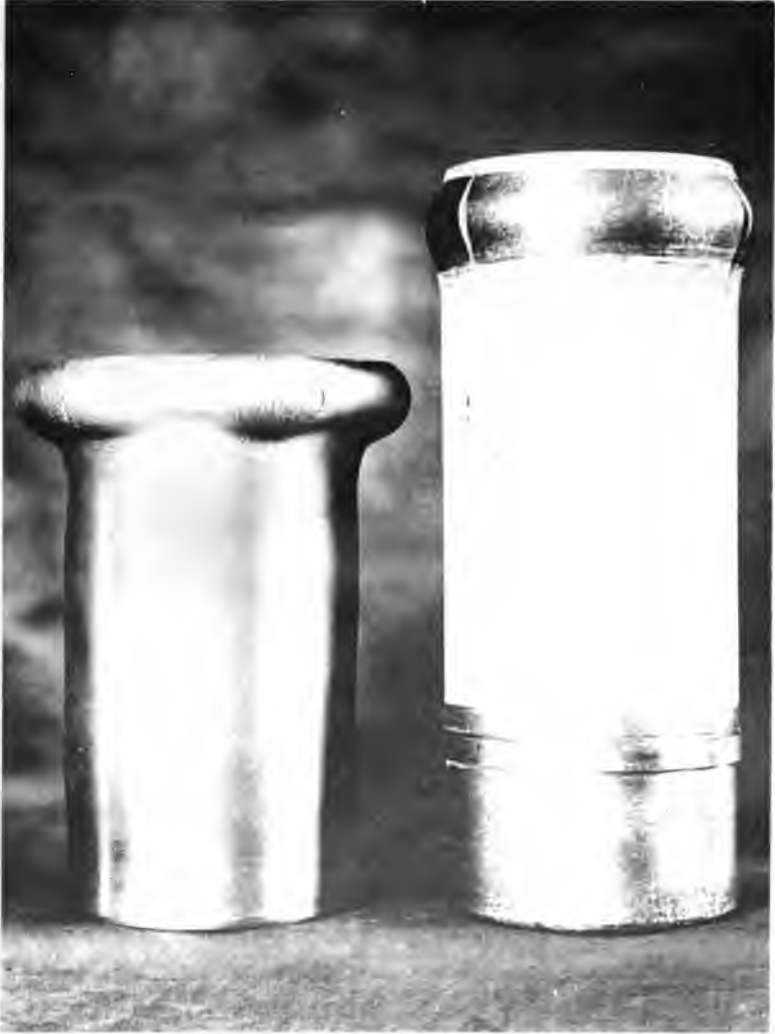
BENDING SPECIMENS.



No. of test.	Description.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 8 inches.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.	Bending test.
10548	2.58-inch bolt for Fort Stark, N. H.	<i>Inches.</i> 1.129	<i>Sq. inch.</i> 1.00	<i>Pounds.</i> 30,100	<i>Pounds.</i> 57,300	<i>Per cent.</i> 28.7	<i>Per cent.</i> 43.2	Silky, interspersed with fine granulation.	<i>Inch.</i> .20, .21, .23, .27, .31, .56*, .30, .22.	Bent cold 180° and closed down without fracture.
	1.75-inch bolt for Fort Stark, N. H.	1.129	1.00	38,400	61,100	30.5	55.8	Fine silky, cup-shaped.	.16, .22, .27, .35, .72*, .31, .22, .18.	Do.
	2-inch bolt for Fort Standish	1.129	1.00	36,900	65,400	29.8	55.8	Silky, cup-shaped	.19, .23, .26, .37*, .36, .27, .22, .15.	Bent cold 180° without fracture, in closing down upon itself, a fracture developed on the inside of the bend.

SHRAPNEL CASES.



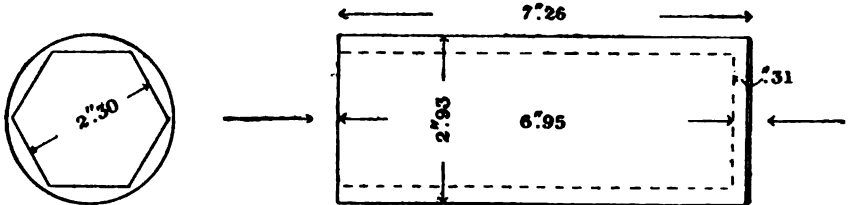


DRAWN HEXAGONAL AND EHRHARDT SHRAPNEL CASES, AFTER TESTS BY COMPRESSION.

SHRAPNEL CASES RECEIVED FROM FRANKFORD ARSENAL.

DRAWN HEXAGONAL STEEL CASE.

COMPRESSION TEST.



Marks, 75-mm. V. M.

Sectional area, about 2.16 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
2,160	1,000	0.	0.	Initial load.
10,800	5,000	.0008	0.	
21,600	10,000	.0015	0.	
32,400	15,000	.0023	0.	
48,200	20,000	.0030	0.	
54,000	25,000	.0037	0.	
64,800	30,000	.0045	0.	
75,600	35,000	.0054	.0001	
77,760	36,000	.0057	.....
79,320	37,000	.0060	.....
82,080	38,000	.0063	.....
84,240	39,000	.0065	.....
86,400	40,000	.0069	.0009	
88,560	41,000	.0072	.....
90,720	42,000	.0077	.....
92,880	43,000	.0082	.....
95,040	44,000	.0085	.....
97,200	45,000	.0092	.0023	
99,360	46,000	.0100	.....
101,520	47,000	.0107	.....
103,680	48,000	.0118	.....
105,840	49,000	.0130	.....
108,000	50,000	.0145	.0067	
112,320	52,000	.0178	.....
116,640	54,000	.0234	.....
120,960	56,000	.0306	.0213	
154,000	71,300	Ultimate strength.

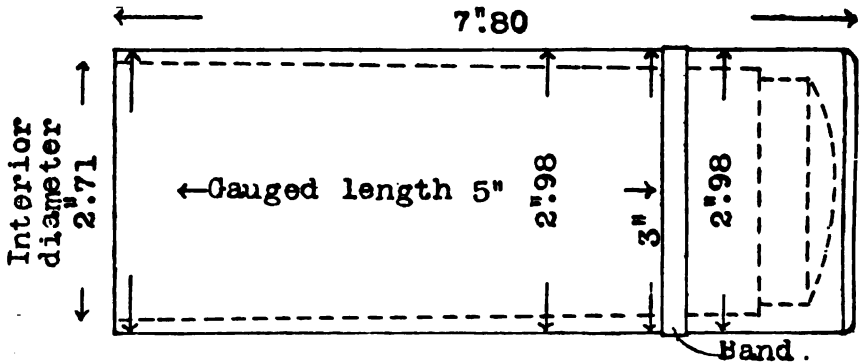
The case buckled near the forward end. The buckling was continued, the loads of compression in the meantime gradually falling until the case was reduced to a length of 5".57 over all. At this stage the average diameter over the bulged part was 4".10, and three prominent longitudinal cracks opened on the bulge. These cracks were about midway the sides of the interior hexagon—that is, where the walls were of greatest thickness. At a place 2" from the base of the shell the exterior diameter expanded to 3".01.

The elastic limit of the metal is not well defined. Earlier sets were shown, but the rate of compression did not rapidly increase until a load of 97,200 pounds total was reached.

EHRHARDT SHRAPNEL CASE.

Original length, 8".2. Threaded section cut off.

COMPRESSION TEST.

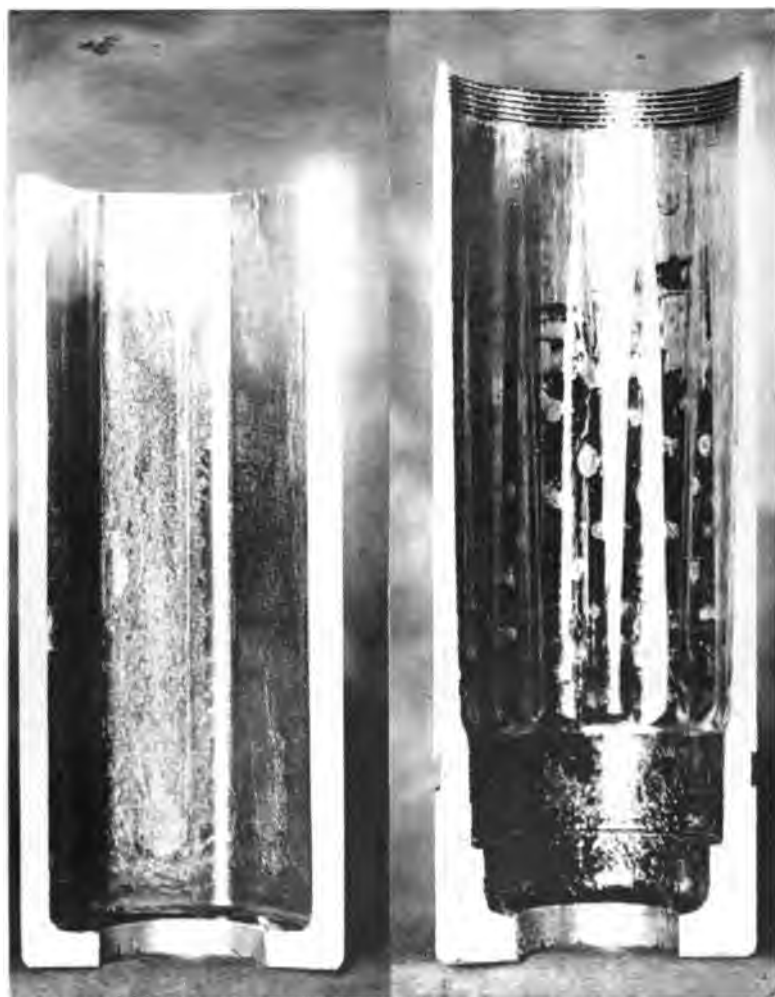


Marks, 158 ⊗ C17-N.R.

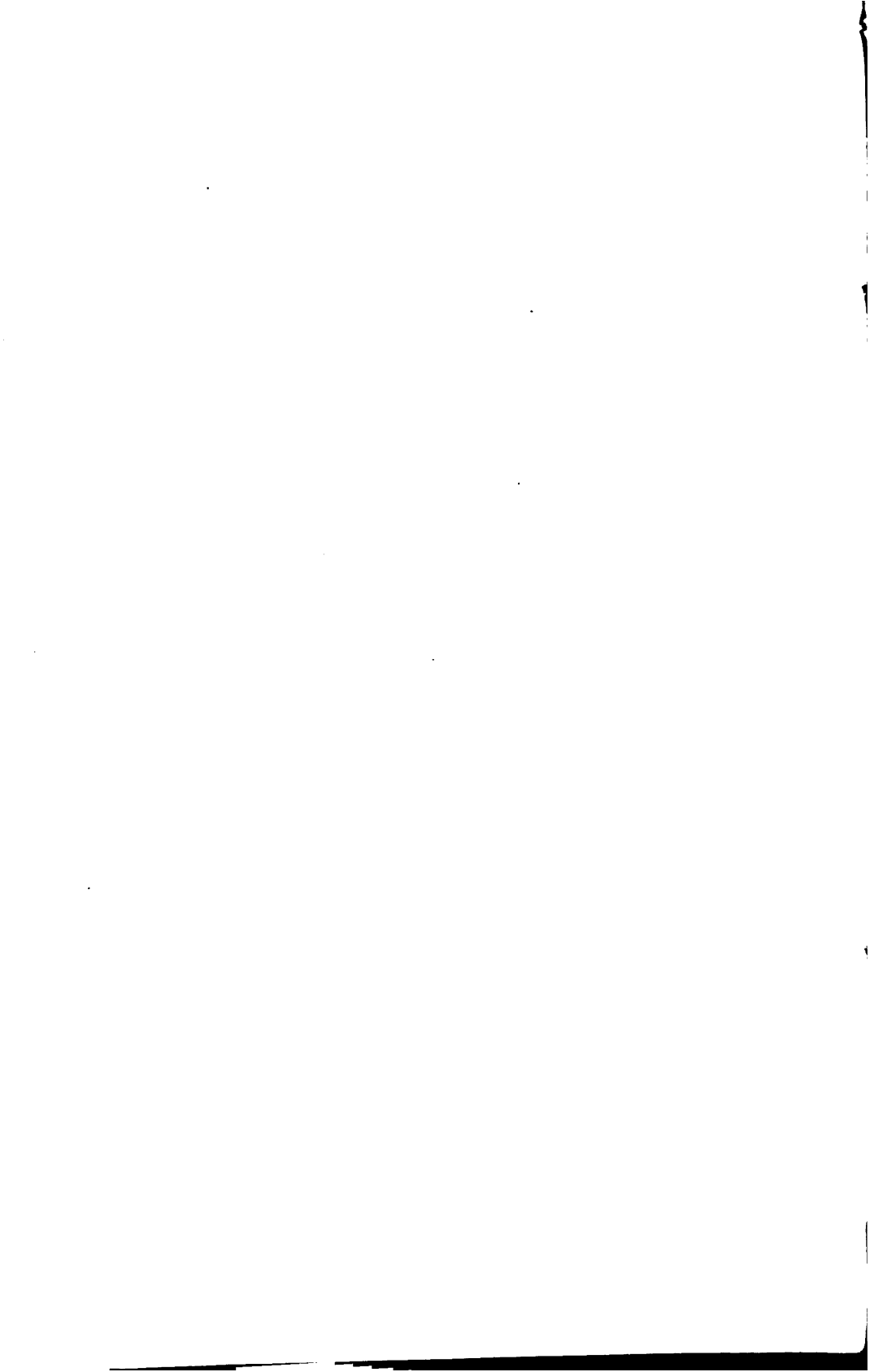
Sectional area, minimum, 1.30 square inch.

Gauged length, established forward of the band, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,300	1,000	0.	0.	
6,500	5,000	.0005	0.	
13,000	10,000	.0011	0.	
19,500	15,000	.0017	0.	
26,000	20,000	.0023	.0001	
32,500	25,000	.0031	.0001	
39,000	30,000	.0037	.0001	
45,500	35,000	.0043	.0002	
46,800	36,000	.0045		
48,100	37,000	.0046		
49,400	38,000	.0047		
50,700	39,000	.0049		
52,000	40,000	.0050	.0002	
53,300	41,000	.0051		
54,600	42,000	.0053		
55,900	43,000	.0054		
57,200	44,000	.0056		
58,500	45,000	.0057	.0003	
59,800	46,000	.0058		
61,100	47,000	.0060		
62,400	48,000	.0061		
63,700	49,000	.0063		
65,000	50,000	.0064	.0003	
67,600	52,000	.0067		
70,200	54,000	.0070		
72,800	56,000	.0072		
75,400	58,000	.0076		
78,000	60,000	.0079	.0003	
80,600	62,000	.0081		
83,200	64,000	.0083		
85,800	66,000	.0086		
88,400	68,000	.0089		
91,000	70,000	.0092	.0004	
93,600	72,000	.0095		
96,200	74,000	.0098		
98,800	76,000	.0101		
101,400	78,000	.0104		
104,000	80,000	.0107	.0006	
106,600	82,000	.0110		
109,200	84,000	.0112		



SECTIONAL VIEWS OF DRAWN HEXAGONAL AND EHRHARDT SHRAPNEL CASES.

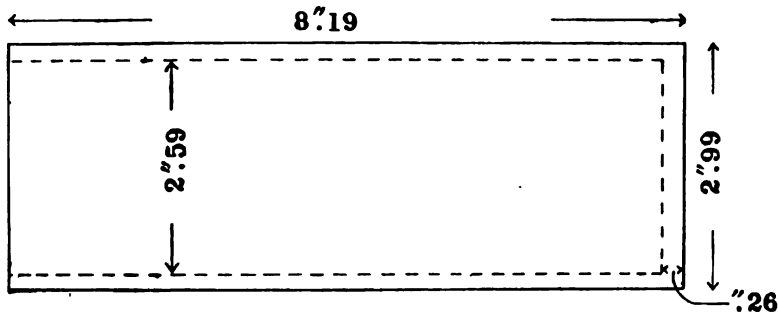


Applied loads.		In gauged loads.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
111,800	86,000	.0116	Ultimate strength.
114,400	88,000	.0119	.....
117,000	90,000	.0121	.0006	
119,600	92,000	.0125	.....
122,200	94,000	.0129	.....
124,800	96,000	.0132	.....
127,400	98,000	.0136	.....
130,000	100,000	.0141	.0010	
132,600	102,000	.0219	.0077	
135,200	104,000	.....	.....
137,800	106,000	.....	.....
140,400	108,000	.....	.....
143,000	110,000	.....	.....
145,600	112,000	.....	.....
148,200	114,000	.....	.....
150,800	116,000	.....	.....
153,400	118,000	.....	.....
156,000	120,000	.....	.....
158,600	122,000	.....	.....
161,200	124,000	.....	.....
163,800	126,000	.....	.....
166,400	128,000	.....	.....
169,000	130,000	.....	.....
171,600	132,000	.....	.....
174,200	134,000	.....	.....
176,800	136,000	.....	.....
179,400	138,000	.....	.....
182,000	140,000	.....	.....
184,600	142,000	.....	.....
187,200	144,000	.....	.....
189,800	146,000	.....	.....

The case buckled near the forward end, at the place of minimum sectional area. The buckling was continued, the load of compression in the meantime falling, until the case was reduced to a length of 7".51 over all. At this stage the average diameter over the bulged part was 3".38, and three longitudinal cracks developed at the bulge. The fractures presented a silky, lamellar appearance. The diameter of the case 2" from the base, immediately in front of the band, was 3".01.

DRAWN CYLINDRICAL CASE.

COMPRESSION TEST.



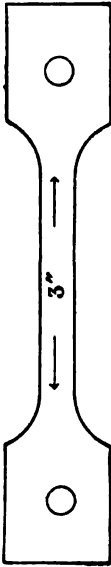
Marks, 3-inch.
 Sectional area, 1.75 square inches.
 Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,750	1,000	0.	0.	Initial load.
8,750	5,000	.0005	0.	
17,500	10,000	.0013	0.	
26,250	15,000	.0022	0.	
36,000	20,000	.0032	0.	
48,750	25,000	.0040	0.	
52,500	30,000	.0048	.0001	
61,250	35,000	.0057	.0001	
68,000	36,000	.0060	.....
64,750	37,000	.0062	.....
66,500	38,000	.0064	.....
68,250	39,000	.0067	.....
70,000	40,000	.0070	.0005	
71,750	41,000	.0074	.....
73,500	42,000	.0077	.....
75,250	43,000	.0081	.....
77,000	44,000	.0086	.....
78,750	45,000	.0091	.0018	
80,500	46,000	.0098	.....
82,250	47,000	.0106	.....
84,000	48,000	.0112	.....
85,750	49,000	.0118	.....
87,500	50,000	.0131	.0046	
91,000	52,000	.0158	.....
94,500	54,000	.0190	.....
98,000	56,000	.0230	.....
101,500	58,000	.0284	.....
105,000	60,000	.0360	.0250	Ultimate strength.
125,600	71,710	.....	.....

Walls bulged near the forward end of the case. After passing the maximum resistance deformation was continued until the diameter over the bulge measured 3".81, the length over all now being 7".15. At a place 2" forward of the base the diameter is 3".02. Incipient fractures developed on the bulge.

TENSILE TESTS OF METAL FROM SHRAPNEL CASES.

LONGITUDINAL SPECIMENS.



Description of case.	Dimensions.		Sec-tional area.	Elastic limit.		Tensile strength.		Elongation in 8 inches.		Area at fracture.	Contraction of area.	Appear-ance of fracture.	Elongation of 2-inch sections
	Width.	Thick-ness.		Total.	Per square inch.	Total.	Per square inch.	Inch.	Percent.				
Ehrhardt	.495	.125	.062	Pounds.	Pounds.	Pounds.	Pounds.	Inch.	Percent.	Inch.	Sq. inch.	Per cent.	" "
Do	.494	.125	.062	4,600	74,190	7,810	117,900	.84	11.3	.41 × .10 = .041		33.9	.05, .08, .21*
				4,900	79,080	7,600	122,880	.80	10.0	.42 × .10 = .042		32.8	.05, .07, .18*
Do	.498	.125	.062	3,400	54,840	3,600	58,060	.22	7.3	.38 × .08 = .080		51.6	.00, .00, .22*
Do	.500	.125	.063	3,650	57,940	3,750	59,520	.21	7.0	.38 × .08 = .080		52.4	.00, .00, .21*
Drawn cylindrical	.499	.125	.062	4,100	66,190	4,150	66,940	.19	6.3	.40 × .07 = .028		54.8	.00, .19*, .01
Do	.498	.125	.062	4,000	64,520	4,080	65,810	.19	6.3	.41 × .07 = .029		53.2	.01, .01, .17*

CHEMICAL ANALYSES.

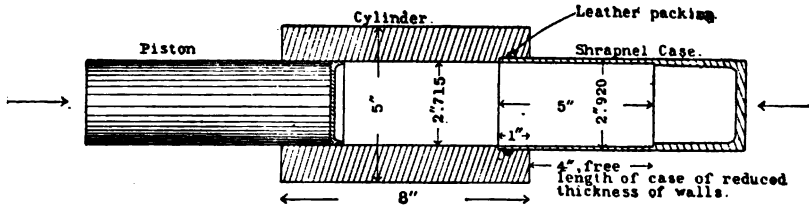
Description.	Carbon.	Manga-nese.	Silicon.	Sulphur.	Phos-phorus.
Ehrhardt	.63	.86	.29	.044	.019
Hexagonal	.22	.42	.01	.088	.049
Cylindrical	.16	.30	.01	.017	.028

TESTS OF SHRAPNEL CASES BY MEANS OF INTERIOR HYDROSTATIC PRESSURES.

Cases tested:

- 1 Ehrhardt case.
- 1 Drawn case, cylindrical interior.
- 1 Drawn case, hexagonal interior.

TESTING ATTACHMENT.



Each case turned to an exterior diameter of 2".92, and bored to 2".715 interior diameter for a distance of 5" of its length. Tests were made by means of interior hydrostatic pressure, using the testing attachment above shown. This attachment consisted of a cylinder carrying a piston with a cup leather packing at one end, and counter-bored for a distance of 1" to receive the shrapnel case at the other end. A grooved recess carried a leather packing at this end.

A yoke, not sketched, was used over the outside ends of the cylinder and shrapnel case, and kept these parts together against the hydrostatic pressure which acted upon the annular surface of the end of the case, tending to blow it away from the cylinder.

Sectional area of the piston, 5.79 square inches.

EHRHARDT CASE.

Applied loads.			Exterior diameter of case.	Remarks.	
Total load on piston.	Interior pressure per square inch.	Fiber stress on case per square inch.			
Pounds.	Pounds.	Pounds.	Inches.		
0	0	0	2.92	Elastic limit; rapid yielding.	
38,000	6,563	92,500	2.94		
40,000	6,908	.....	2.96	
45,000	7,772	.....	2.99	
50,000	8,636	.....	3.03	
55,000	9,499	.....	3.10	
59,000	10,190	.....	3.14	
61,000	10,535	.....	.....
61,200	10,570	148,984		Ultimate strength.

Case ruptured longitudinally. Appearance of fracture, fine granular, radiating from a spot of serrated metal, the place at which rupture began.

DRAWN CASE, CYLINDRICAL INTERIOR.

Applied loads.			Exterior diameter of case.	Remarks.
Total load on piston.	Interior pressure per square inch.	Fiber stress on case per square inch.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	
0	0	0	2.92	
82,000	5,527	-----	2.98	
84,600	5,976	84,230	2.99	Elastic limit, rapid yielding, and ultimate strength.

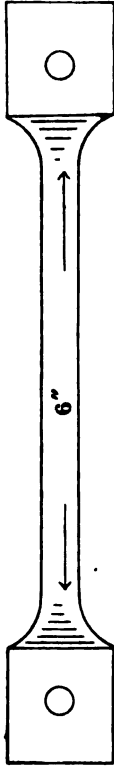
The metal of the case drew down along spiral lines, which intersected each other. Rupture occurred in a spiral direction, the ends of the fracture approaching a longitudinal course. Appearance of fracture, fine granular.

DRAWN CASE, HEXAGONAL INTERIOR.

Applied loads.			Exterior diameter of case.	Remarks.
Total load on piston.	Interior pressure per square inch.	Fiber stress on case per square inch.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	
0	0	0	2.92	
30,000	5,181	73,030	2.98	Elastic limit.
31,000	5,354	-----	2.96	
31,800	5,492	77,410	-----	Ultimate strength.

Longitudinal line of rupture. Appearance of fracture, medium granular.

TENSILE TESTS OF METAL FROM A 6-INCH CYLINDRICAL SHEAPNEL CASE FROM FRANKFORD ARSENAL.
LONGITUDINAL SPECIMENS.



Dimensions.		Elastic limit.		Tensile strength.		Elongation in 6 inches.		Area at fracture.		Contraction of area.		Appearance of fracture.		Elongation of inch sections.				
Width.	Thick-ness.	Total.	Per square inch.	Total.	Per square inch.	Inches.	Per cent.	Inch.	Sq. in.	Per cent.	Per cent.			"	"			
.499	.202	4,250	41,780	8,720	86,340	1.06	17.7	.43 × .17 =	.073	27.7	Granular, in part silky.....		.14,	.15,	.19,	.29*	.14	
.499	.202	4,260	42,180	8,710	86,240	.94	15.7	.46 × .17 =	.077	28.8do.....		.12,	.13,	.16,	.18,	.21*	.14

CHEMICAL ANALYSIS.

Carbon.	Manga-nese.	Silicon.	Sulphur.	Phos-phorus.
.52	.70	.25	.083	.042



PHOTOGRAPH OF EHRHARDT SHRAPNEL CASE, AFTER RUPTURE BY
INTERIOR HYDROSTATIC PRESSURE.

HELIOTYPE CO., BOSTON.





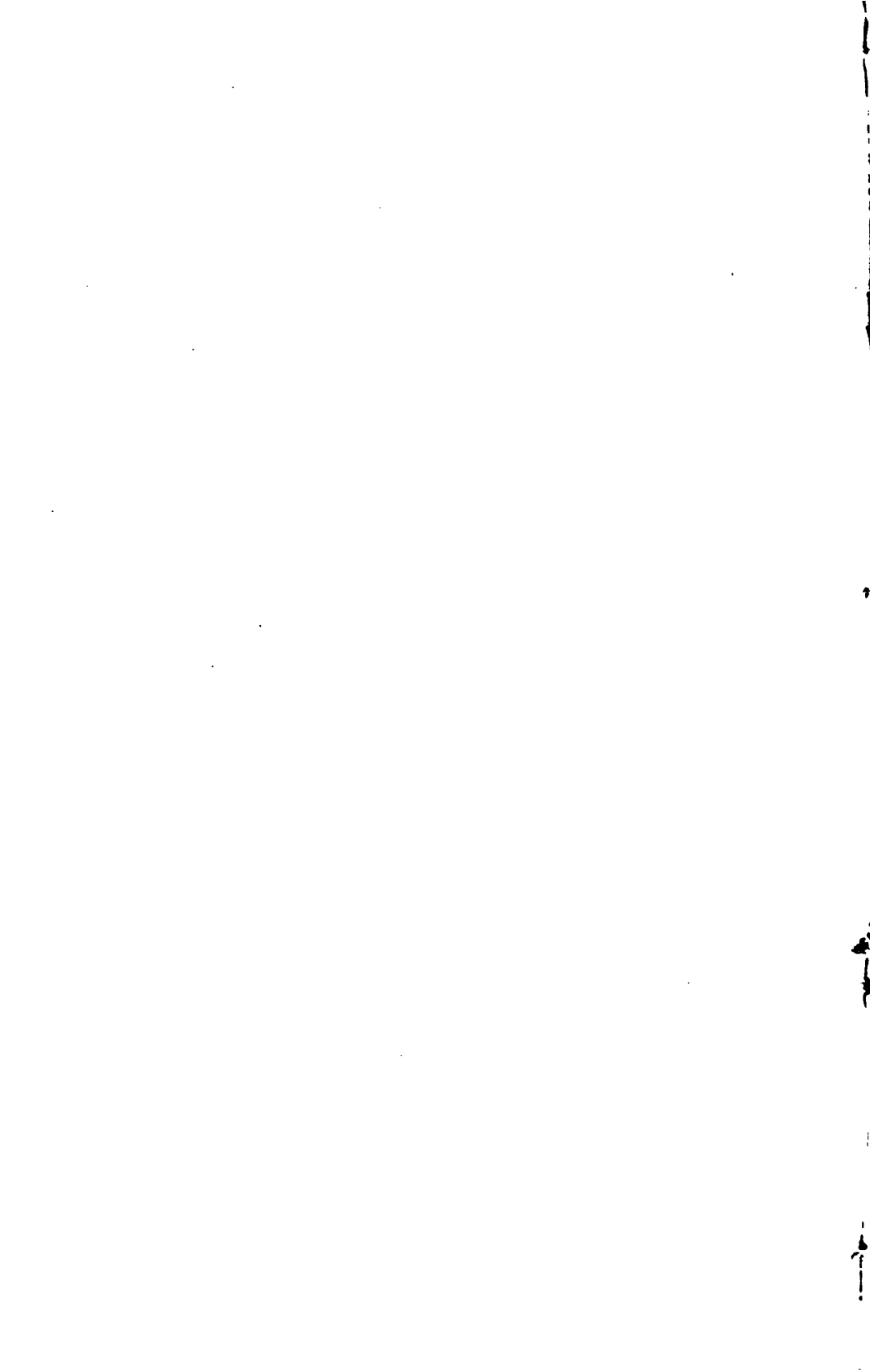
PHOTOGRAPH OF DRAWN CYLINDRICAL SHRAPNEL CASE, AFTER RUPTURE BY
INTERIOR HYDROSTATIC PRESSURE.



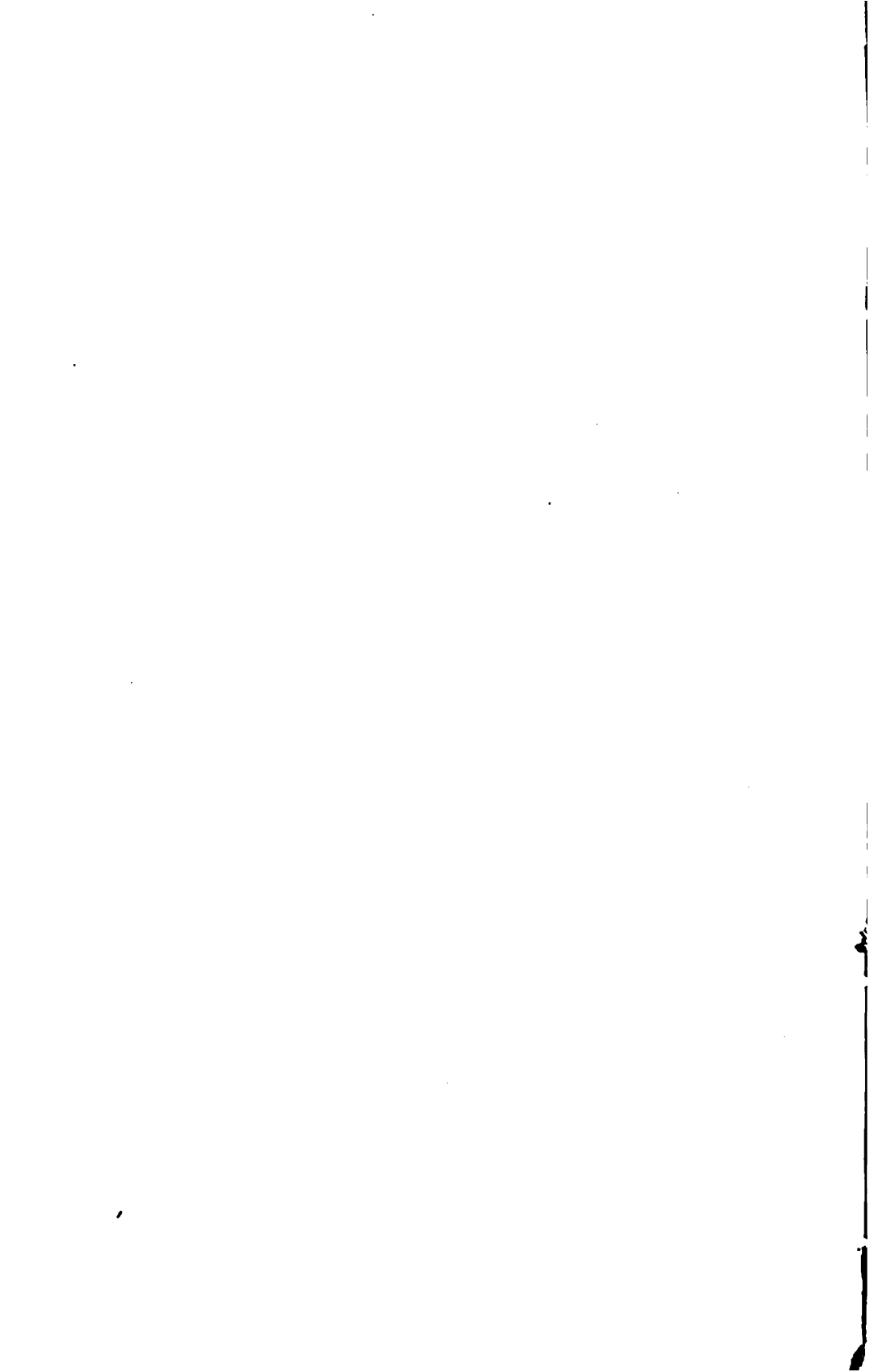


PHOTOGRAPH OF DRAWN HEXAGONAL SHRAPNEL CASE, AFTER RUPTURE BY
INTERIOR HYDROSTATIC PRESSURE.

HELIO TYPE CO., BOSTON.



**RESISTANCE OF JACKETED BULLETS WHEN FORCED
THROUGH THE BORE OF .30-CALIBER
RIFLE BARRELS.**



JACKETED BULLETS FORCED THROUGH .30-CALIBER RIFLE BARRELS.

Tests were made with barrels having twist of the rifling of 1 turn in 10" and 1 turn in 8", respectively. Jacketed bullets used having bearing surfaces $\frac{1}{4}$ ", $\frac{3}{8}$ ", and $\frac{1}{2}$ " long, respectively.

No. 10648.

Barrel having twist of 1 turn in 10".

Bearing of bullet, $\frac{1}{4}$ ".

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	Inches.	Foot.	h. m. s.	
0	0.	0.	1 28 0	
97	.05	.004	1 29 0	
106	.07	.008	1 29 30	
179	.10	.008	1 30 30	
269	.15	.008	1 31 0	
354	.20	.008	1 31 30	
378	.22			
486	.25	.001	1 38 0	
588	.30	.004	1 39 0	
790	.35	.004	1 40 0	
874	.40	.006	1 40 45	
966	.45	.017	1 41 0	
1,007	.50	.004	1 42 0	
1,048	.55	.004	1 43 0	
1,044	.60	.008	1 43 30	
1,088	.65			
990	.70	.017	1 41 0	
980	.75			
860	.80	.008	1 45 0	
775	.90			
720	1.00	.017	1 46 0	
700	1.10			
688	1.20	.017	1 47 0	
692	1.30			
720	1.40	.011	1 48 30	
720	1.50	.017	1 49 0	
702	1.60	.008	1 50 0	
676	1.80	.017	1 51 0	
700	2.00	.017	1 52 0	
662	2.20	.033	1 52 30	
658	2.50	.017	1 54 0	
624	2.80	.050	1 54 30	
636	3.00	.033	1 55 0	
635	3.50	.042	1 56 0	
615	4.00	.042	1 57 0	
625	5.00	.042	1 59 0	
565	5.05		2 9 0	Changed pistons.
684	6.00	.058	2 10 30	
682	7.00	.056	2 12 0	
692	8.00	.083	2 13 0	
685	9.00	.056	2 14 30	
678	10.00	.056	2 16 0	
712	11.00	.083	2 17 0	
662	11.05		2 27 0	Changed pistons.
636	12.00	.079	2 28 0	
600	13.00	.083	2 29 0	
602	14.00	.083	2 30 0	
573	15.00	.083	2 31 0	
596	16.00	.083	2 32 0	
616	17.00	.083	2 33 0	
580	18.00	.083	2 34 0	
571	19.00	.083	2 35 0	
574	19.05		2 45 0	Changed pistons.
588	20.00	.079	2 46 0	
662	21.00	.083	2 47 0	

Barrel having twist of one turn in 10".
 Bearing of bullet, $\frac{3}{8}$ ".

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.			Remarks.
Pounds.	Inches.	Foot.	h.	m.	s.	
0	0.	.....	10	51	0	
42	.06	.....			
86	.10	.....			
130	.15	.....			
195	.20	.....			
278	.25	.....			
342	.30	.008	10	54	0	
422	.35	.....			
504	.40	.....			
586	.45	.....			
665	.50	.....			
760	.55	.....			
830	.60	.....			
862	.65	.007	10	58	0	
874	.70	.....			
875	.75	.....			
825	.80	.....			
812	.90	.010	11	00	0	
782	1.00	.....			
780	1.10	.....			
776	1.20	.025	11	01	0	
755	1.30	.....			
722	1.50	.013	11	03	0	
808	1.80	.017	11	04	30	
922	2.00	.011	11	06	0	
956	2.20	.088	11	06	30	
1,008	2.50	.025	11	07	30	
916	2.80	.....			
898	3.00	.042	11	08	30	
783	3.50	.028	11	10	0	
750	4.00	.042	11	11	0	
770	5.00	.042	11	13	0	Changed pistons.
737	5.05	.....	11	21	0	
916	6.00	.040	11	23	0	
978	7.00	.056	11	24	30	
998	8.00	.083	11	25	30	
970	9.00	.067	11	26	45	
948	10.00	.067	11	28	0	
952	11.00	.083	11	29	0	Changed pistons.
953	11.03	.....	11	36	0	
912	12.00	.081	11	37	0	
830	13.00	.111	11	37	45	
861	14.00	.111	11	38	30	
832	15.00	.083	11	39	30	
850	16.00	.111	11	40	15	
862	17.00	.111	11	41	0	
846	18.00	.167	11	41	30	
838	19.00	.083	11	42	30	Changed pistons.
944	19.01	.....	11	51	0	
905	19.05	.002	11	52	30	
899	20.00	.045	11	54	15	
990	21.00	.048	11	56	0	
900	21.20	.....			
820	21.30	.....			
640	21.40	.....			
190	21.50	.....			
200	21.70	.....			

No. 10650.

Barrel having twist of one turn in 10".
 Bearing of bullet, 1/4".

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	Inches.	Foot.	h. m. s.	
0	0.	.....	1 06 0	
68	.06	.....	.....
97	.10	.....	.....
184	.15	.....	.....
184	.20	.....	.....
282	.25	.....	.....
275	.30	.....	.....
328	.35	.....	.....
384	.40	.....	.....
430	.45	.006	1 12 0	
498	.50	.....	.....
568	.55	.....	.....
658	.60	.....	.....
755	.65	.....	.....
788	.70	.....	.....
806	.75	.....	.....
800	.80	.008	1 15 30	
720	.90	.011	1 16 15	
698	1.00	.017	1 16 45	
710	1.10	.....	.....
784	1.20	.010	1 18 30	
785	1.30	.017	1 19 0	
780	1.50	.022	1 19 45	
826	1.80	.025	1 20 45	
880	2.00	.083	1 21 15	
876	2.20	.088	1 21 45	
884	2.50	.083	1 22 30	
876	3.00	.042	1 23 30	
816	3.50	.042	1 24 30	
708	4.00	.056	1 25 15	
730	5.00	.048	1 27 0	
690	5.02	.....	1 33 0	Changed pistons.
704	5.05	.008	1 34 0	
852	6.00	.026	1 37 0	
1,024	7.00	.056	1 38 30	
1,080	7.80	.....	.....
990	8.00	.056	1 40 0	
998	9.00	.067	1 41 15	
1,000	10.00	.067	1 42 30	
1,086	11.00	.083	1 43 30	
982	11.05	.....	1 56 0	Changed pistons.
1,060	11.70	.....	.....
1,020	12.00	.040	1 58 0	
940	13.00	.083	1 59 0	
845	14.00	.083	2 0 0	
826	15.00	.083	2 01 0	
848	16.00	.083	2 02 0	
884	17.00	.083	2 03 0	
910	18.00	.083	2 04 0	
946	19.00	.083	2 05 0	
990	19.02	.....	2 16 0	Changed pistons.
915	19.05	.005	2 16 30	
1,040	20.00	.158	2 17 0	
1,020	21.00	.083	2 18 0	
700	21.40	.....	.....

No. 10651.

Barrel having twist of one turn in 10".
Bearing of bullet, $\frac{1}{4}$ ".

Resist- ance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	Inches.	Foot.	h. m. s.	
0	0.		3 12 0	
85	.05			
64	.10			
102	.15			
167	.20			
230	.25	.007	3 15 0	
295	.30			
372	.35			
460	.40			
545	.45	.008	3 17 0	
616	.50			
710	.55	.008	3 18 0	
768	.60			
778	.65	.007	3 19 15	
796	.70			
800	.75			
770	.80			
715	.85			
712	.90	.012	3 21 0	
730	1.00			
730	1.10	.022	3 21 45	
756	1.20	.017	3 22 15	
793	1.30	.083	3 22 30	
788	1.50	.022	3 23 15	
925	1.80	.025	3 24 15	
958	2.00	.022	3 25 0	
976	2.20	.083	3 25 30	
953	2.50	.083	3 26 15	
840	2.80			
940	3.00	.083	3 27 30	
918	3.50	.042	3 28 30	
896	4.00	.042	3 29 30	
940	5.00	.083	3 30 30	
				Changed pistons.
853	5.01		3 38 0	
914	5.05	.002	3 39 45	
1,030	6.00	.045	3 41 30	
1,036	7.00	.056	3 43 0	
1,096	8.00	.083	3 44 0	
1,124	9.00	.083	3 45 0	
1,160	10.00	.083	3 46 0	
1,145	11.00	.083	3 47 0	
				Changed pistons.
1,050	11.05		3 55 0	
1,180	11.80			
1,140	12.00	.063	3 56 15	
1,220	12.60			
1,130	13.00	.048	3 58 0	
1,121	14.00	.083	3 59 0	
1,197	15.00	.167	3 59 30	
1,155	16.00	.111	4 0 15	
1,182	17.00	.083	4 01 15	
1,284	18.00	.111	4 02 0	
1,300	19.00	.083	4 03 0	
Bullet remained in barrel 17 hours, after which the test was completed.				
1,280	19.01			
1,046	19.02			
1,058	19.03			
1,070	19.04			
1,080	19.05			
1,150	19.10			
1,390	19.50			
1,640	20.00			
1,640	20.30			
1,610	20.50			
1,670	20.80			
1,450	21.00			
1,000	21.40			
700	21.50			
400	21.65			
0	21.85			

a Approximate.

TESTS ON THE MAXIMUM RESISTANCE OF BULLETS FORCED THROUGH THE BARREL
AT A SPEED OF ABOUT 1 FOOT PER MINUTE.

Barrel having twist of one turn in 10".

No. of test.	Bearing of bullet.	Maximum resistance.	Remarks.
10652	<i>Inch.</i> ↓	<i>Pounds,</i> 1,800	1,450 pounds resistance until bullet had traveled nearly through.
10653	↓	2,200	
10654	↓	1,700	

The barrels were perceptibly warmed during the passage of the bullets at 1 foot per minute velocity.

No. 10655.

Barrel having twist of one turn in 8".
Bearing of bullet, $\frac{1}{4}$ ".

Resist- ance.	Distance traveled.	Velocity per min- ute.	Time of observation.	Remarks.
Pounds.	Inches.	Foot.	h. m. s.	
0	0.		12 56 0	
56	.05			
101	.10			
176	.15			
244	.20	.008	12 58 0	
383	.25			
482	.30			
588	.35			
688	.40			
788	.45	.010	1 0 0	
866	.50			
892	.55			
934	.60	.010	1 01 15	
966	.65			
955	.70			
986	.75	.010	1 02 30	
890	.80			
838	.90	.013	1 03 30	
780	1.00	.011	1 04 15	
754	1.10	.017	1 04 45	
762	1.20	.011	1 05 30	
783	1.30	.017	1 06 0	
828	1.50	.022	1 06 45	
806	1.80	.020	1 08 0	
804	2.00	.022	1 08 45	
818	2.20	.033	1 09 15	
825	2.50	.025	1 10 15	
808	3.00	.033	1 11 30	
825	3.50	.056	1 12 15	
792	4.00	.056	1 13 0	
793	5.00	.088	1 14 0	Changed pistons.
640	5.02		1 23 0	
690	5.05	.008	1 24 0	
745	6.00	.040	1 26 0	
780	7.00	.083	1 27 0	
767	8.00	.083	1 28 0	
804	9.00	.083	1 29 0	
777	10.00	.083	1 30 0	
787	11.00	.083	1 31 0	Changed pistons.
640	11.01		1 39 0	
640	11.02			
640	11.03			
650	11.04			
655	11.05			
665	11.06			
665	11.08			
665	11.10	.008	1 41 30	
710	11.50	.083	1 42 30	
657	12.00	.083	1 43 0	
658	13.00	.083	1 44 0	
635	14.00	.083	1 45 0	
650	15.00	.083	1 46 0	
666	16.00	.083	1 47 0	
648	17.00	.083	1 48 0	
667	18.00	.083	1 49 0	
648	19.00	.083	1 50 0	Changed pistons.
485	19.01		2 08 30	
582	19.02			
576	19.03			
578	19.04			
578	19.05	.001	2 11 15	
586	19.10	.017	2 11 30	
592	19.20	.008	2 12 30	
628	20.00	.033	2 14 30	
625	21.00	.056	2 16 0	
850	21.50			

No. 10656.

Barrel having twist of one turn in 8".
Bearing of bullet, $\frac{3}{8}$ ".

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.	Remarks.
Pounds.	Inches.	Foot.	h. m. s.	
0	0.		2 40 0	
54	.05			
92	.10			
152	.15			
282	.20	.004	2 43 45	
302	.25			
370	.30			
447	.35			
525	.40	.008	2 45 45	
623	.45	.006	2 46 30	
700	.50	.008	2 47 0	
812	.55	.008	2 47 30	
894	.60	.008	2 48 0	
925	.65			
942	.70	.008	2 49 0	
956	.75			
922	.80	.011	2 49 45	
861	.90	.011	2 50 30	
888	1.00	.011	2 51 15	
812	1.10	.017	2 51 45	
806	1.20	.017	2 52 15	
814	1.30			
825	1.50	.025	2 53 15	
874	1.80	.033	2 54 0	
920	2.00	.033	2 54 30	
942	2.20	.033	2 55 0	
947	2.50	.050	2 55 30	
954	3.00	.056	2 56 15	
984	3.50	.056	2 57 0	
1,000	4.00	.063	2 57 30	
1,068	5.00	.067	2 58 45	
920	5.01		3 03 30	Changed pistons.
956	5.05			
1,049	6.00	.056	3 04 45	
1,065	7.00	.067	3 05 0	
1,113	8.00	.067	3 07 15	
1,152	9.00	.063	3 08 15	
1,125	10.00	.063	3 09 15	
1,146	11.00	.063	3 10 15	Changed pistons.
1,185	11.01		3 18 30	
1,100	11.05	.002	3 20 0	
1,296	11.50	.033	3 21 0	
1,300	12.00	.056	3 21 45	
1,126	13.00	.056	3 23 15	
1,083	14.00	.067	3 24 30	
1,100	15.00	.063	3 25 30	
1,105	16.00	.067	3 26 45	
1,218	17.00	.063	3 27 45	
1,285	18.00	.063	3 28 45	
1,243	19.00	.063	3 29 45	Changed piston.
900	19.01		3 36 30	
1,200	19.03			
1,132	19.05			
1,146	20.00	.028	3 39 30	
1,125	21.00	.063	3 40 30	
640	21.50			

No. 10657.

Barrel having twist of one turn in 8".
Bearing of bullet, $\frac{1}{8}$ ".

Resistance.	Distance traveled.	Velocity per minute.	Time of observation.			Remarks.
			A.	m.	s.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Foot.</i>	<i>9</i>	<i>14</i>	<i>0</i>	
0	0.					
38	.05					
60	.10					
102	.15					
152	.20					
196	.25					
266	.30					
314	.35					
376	.40					
446	.45					
520	.50	.006	9	21	30	
592	.55					
662	.60					
710	.65	.006	9	23	45	
748	.70					
758	.75	.011	9	24	30	
767	.80	.006	9	25	0	
766	.90	.011	9	25	45	
782	1.00	.017	9	26	15	
724	1.10	.083	9	26	30	
702	1.20	.017	9	27	0	
708	1.30	.017	9	27	30	
761	1.50	.022	9	28	15	
802	1.80	.025	9	29	15	
834	2.00	.067	9	29	30	
859	2.20	.022	9	30	15	
884	2.50	.050	9	30	45	
930	3.00	.042	9	31	45	
926	3.50	.056	9	32	30	
966	4.00	.056	9	33	15	
1,013	5.00	.083	9	34	15	
800	5.01		9	41	45	Changed pistons.
895	5.02					
896	5.03					
898	5.04					
898	5.05					
940	5.10	.008	9	44	30	
1,052	6.00	.075	9	45	30	
1,106	7.00	.067	9	46	45	
1,156	8.00	.083	9	47	45	
1,182	9.00	.088	9	48	45	
1,115	10.00	.083	9	49	45	
1,077	11.00					Changed pistons.
985	11.01		9	56	15	
975	11.03					
984	11.05	.002	9	58	15	
1,022	11.10	.003	9	59	30	
1,080	12.00	.030	10	02	0	
1,112	13.00	.067	10	03	15	
1,156	14.00	.083	10	04	15	
1,198	15.00	.083	10	05	15	
1,142	16.00	.083	10	06	15	
1,140	17.00	.083	10	07	15	
1,042	18.00	.083	10	08	15	
1,052	19.00	.083	10	09	15	
700	19.01		10	14	15	Changed pistons.
970	19.03					
968	19.05	.001	10	16	30	
982	19.10	.006	10	17	0	
998	20.00	.060	10	18	15	
1,060	21.00	.167	10	18	45	

No. 10658.

Barrel having twist of one turn in 8".

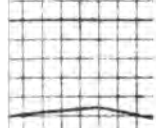
Bearing of bullet, $\frac{1}{4}$ ".

Resist- ance.	Distance traveled.	Velocity per minute.	Time of observation.			Remarks.
Pounds.	Inches.	Foot.	h.	m.	s.	
0	0.	.....	11	09	30	
52	.05	.....	.....	.....	.....
56	.10	.....	.....	.....	.....
144	.15	.....	.....	.....	.....
212	.20	.....	.....	.....	.....
282	.25	.....	.....	.....	.....
387	.30	.....	.....	.....	.....
502	.35	.....	.....	.....	.....
590	.40	.005	11	16	15	
670	.45	.....	.....	.....	.....
781	.50	.....	.....	.....	.....
880	.55	.007	11	18	0	
910	.60	.....	.....	.....	.....
925	.65	.....	.....	.....	.....
938	.70	.....	.....	.....	.....
908	.75	.....	.....	.....	.....
869	.80	.....	.....	.....	.....
855	.90	.....	.....	.....	.....
830	1.00	.....	.....	.....	.....
800	1.20	.014	11	22	0	
795	1.30	.....	.....	.....	.....
740	1.50	.017	11	23	30	
724	1.80	.020	11	24	45	
708	2.00	.022	11	25	30	
718	2.20	.017	11	26	30	
782	2.50	.020	11	27	45	
746	3.00	.056	11	28	30	
770	3.50	.021	11	30	30	
800	4.00	.042	11	31	30	
810	5.00	.056	11	33	0	Changed pistons.
720	5.01	.....	11	40	30	
723	5.03	.....	.....	.....	.....
725	5.05	.002	11	42	30	
788	6.00	.023	11	46	0	
815	7.00	.067	11	47	15	
850	8.00	.083	11	48	15	
900	9.00	.083	11	49	15	
918	10.00	.083	11	50	15	
939	11.00	.083	11	51	15	Changed pistons.
760	11.01	.....	11	56	30	
786	11.03	.....	.....	.....	.....
784	11.05	.....	.....	.....	.....
860	12.00	.028	11	59	30	
814	13.00	.083	12	0	30	
786	14.00	.083	12	01	30	
795	15.00	.083	12	02	30	
818	16.00	.083	12	03	30	
866	17.00	.098	12	04	30	
882	18.00	.083	12	05	30	
822	19.00	.083	12	06	30	Changed pistons.
Rested 1 hour 6 minutes.						
430	19.01	1	12	30	
800	19.03	
740	19.05	
782	20.00	.021	1	16	30	
740	21.00	.083	1	17	30	

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RESISTANCE OF JACKETED BULLETS.

TESTS ON THE MAXIMUM RESISTANCE OF BULLETS FORCED THROUGH THE BARREL
AT A SPEED OF ABOUT 1 FOOT PER MINUTE.

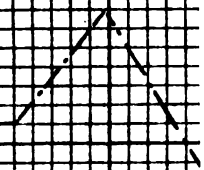
Barrel having twist of one turn in 8 inches.

No. of test.	Bearing of bullet.	Maximum resistance.	Remarks.
	<i>Inch.</i>	<i>Pounds.</i>	
10659	↑	890	
10660	↑	1,450	
10661	↑	1,800	
10662	↑	1,220	
10663	↑	1,680	
10664	↑	1,640	
Additional tests with barrel having twist of one turn in 10 inches.			
10665	↑	1,000	
10666	↑	1,560	
10667	↑	2,020	
10668	↑	1,800	

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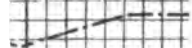


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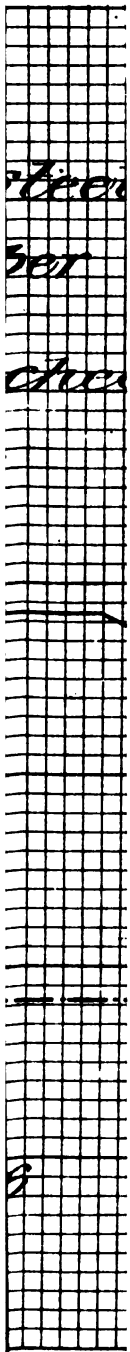
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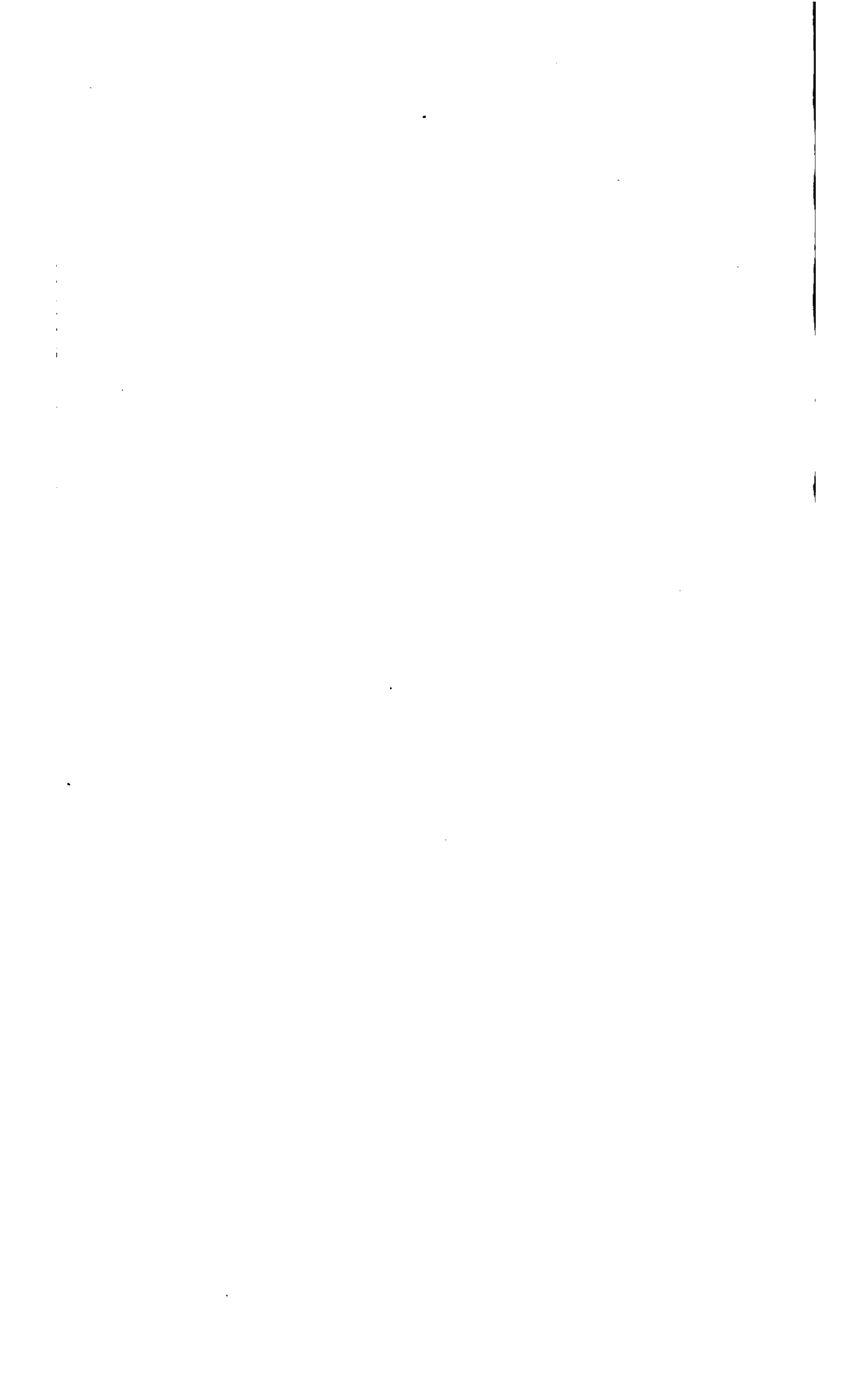


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BRONZE.
BRONZE FROM WATERTOWN ARSENAL FOUNDRY.

Marks.	Description.	Rapid elongation per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
		Pounds.	Pounds.	Per cent.	Per cent.		Inch.
27	Cradle for 75-millimeter field carriage.....	30,210	4.5	.....	.....	Lavender and golden yellow. Broke in shoulder.....	.04, .05
28	do.....	34,620	9.0	13.8	.....	Lavender and golden yellow.....	.06, .12*
29	do.....	33,550	7.5	14.2	.....	do.....	.06, .10*
30	do.....	29,110	9.3	.....	.....	do.....	.04, .10*
31	do.....	32,900	8.0	16.5	.....	do.....	.06, .10*
32	do.....	33,650	10.5	10.7	.....	do.....	.06, .12*
33	do.....	32,490	10.0	12.8	.....	do.....	.06, .12*
34	do.....	29,970	7.0	9.5	.....	do.....	.06, .08*
35	do.....	30,030	6.5	9.0	.....	do.....	.04, .09*
36	do.....	35,470	12.0	16.2	.....	do.....	.14*, .10
37	do.....	28,550	6.5	15.2	.....	do.....	.10*, .03
38	do.....	31,040	7.5	.....	.....	Lavender and golden yellow. Broke at the neck.....	.09*, .06
39	do.....	34,920	8.5	15.2	.....	Lavender and golden yellow.....	.10*, .07
40	do.....	33,490	7.5	.....	.....	do.....	.04, .11*
41	do.....	34,780	9.0	13.2	.....	do.....	.10*, .04
42	do.....	31,780	7.0	12.6	.....	do.....	.07, .07*
43	do.....	34,630	7.0	13.1	.....	Dark yellow center. Lavender at circumference.....	.07, .11*
44	do.....	19,490	6.5	7.0	.....	do.....	.07, .11*
45	do.....	22,320	9.0	14.3	.....	do.....	.07, .12*
46	do.....	24,370	9.5	12.0	.....	do.....	.07, .08*
	Cradle for 75-millimeter field carriage No. 33.....	25,380	7.5	9.8	.....	Lavender and golden yellow.....	.07, .11*
	do.....	26,420	9.0	9.8	.....	do.....	.07, .11*
34	From cradle of 75-millimeter field carriage.....	17,760	7.0	9.8	.....	Golden yellow. Lavender at two places.....	.06, .09*
35	do.....	26,510	10.0	12.1	.....	Light and golden yellow. Lavender at two places.....	.06, .12*
5A	Cradle for 75-millimeter field carriage.....	36,490	11.0	17.4	.....	Dark yellow and lavender colored.....	.09, .13
5A	do.....	28,950	9.0	14.7	.....	Dark yellow, lavender at center.....	.05, .13*
4A	do.....	31,560	12.0	28.9	.....	Dark yellow and lavender colored.....	.09, .15*
6A	do.....	40,110	8.5	13.8	.....	Dark yellow and lavender colored. Broke at the neck.....	.13, .12
7A	do.....	54,310	8.5	22.0	.....	Lavender and golden yellow.....	.07, .10*
8A	do.....	42,890	4.0	22.8	.....	Light and dark yellow.....	.28, .21
8A	do.....	32,720	10.0	.....	.....	Lavender and light yellow. Broke at the neck.....	.04, .04
9A	do.....	37,540	10.0	11.4	.....	Lavender and light yellow.....	.06, .12*
8A	do.....	35,140	9.0	9.1	.....	Lavender and dark yellow.....	.10, .06
9A	do.....	38,160	8.5	9.1	.....	do.....	.06, .09
10A-Y1	do.....	30,960	9.0	11.6	.....	Granular. Lavender at circumference; yellow center.	.12*, .06

BRONZE FROM WATERTOWN ARSENAL FOUNDRY—Continued.

Marks.	Description.	Rapid elongation per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
		Pounds.	Pounds.	Per cent.	Per cent.		Inch.
10A-Y1	Cradle for 75-millimeter field carriage	16,000	32,900	14.0	17.0	Uniform light yellow	.17*
11A-Y1	do	19,870	31,460	7.0	13.9	Dark lavender and yellow intermingled	.08*, .16
12A	do	19,840	35,740	13.5	16.7	do	.10, .16*
11A-Y1	do	17,000	30,660	13.0	16.7	Light yellow	.11, .15*
12A-Y1	do	17,000	33,900	16.0	20.5	Light yellow. Broke at the neck	.06, .07
13A-Y1	do	17,920	34,500	17.0	21.5	Light yellow. Dark spot at circumference	.16*, .18
14A-Y1	do	18,645	34,500	17.0	17.6	Lavender colored at circumference; yellow center	.16*, .09*
14A-Y1	do	21,000	41,400	27.0	23.9	Uniform light yellow	.08*, .08
14A-Y1	do	20,820	39,700	7.0	7.7	Lavender at circumference; yellow center	.08*, .08
15A-Y1	do	17,000	39,700	21.0	20.5	Uniform light yellow	.20, .22*
16A-Y1	do	22,170	35,800	8.0	9.7	Lavender at circumference, yellow center; spongy spot	.10*, .06
17A-Y1	do	18,980	34,330	11.0	13.4	do	.09, .13*
17A-Y1	do	16,500	32,500	12.5	20.5	Uniform light yellow	.15*, .10
16A-Y1	do	17,000	39,000	24.0	23.9	do	.22, .26
18A-Y1	do	19,230	35,940	12.5	9.9	Lavender at circumference, dark yellow center	.17*, .13*
19A-Y1	do	20,840	35,050	9.5	10.0	do	.08, .11*
20A-Y1	do	19,480	34,830	13.0	15.2	do	.11, .15*
18A-Y1	do	18,000	33,100	11.5	13.2	Light yellow with tinge of lavender	.13*, .10
19A-Y1	do	15,500	34,000	13.0	13.2	Light yellow	.14, .12
20A-Y1	do	18,000	40,100	28.5	27.4	do	.27*, .30*
21A-Y1	do	17,000	37,800	22.0	13.2	do	.22, .22
13-BB-25	6" barrette carriage traversing worm gear	25,460	52,730	16.0	19.4	Fine granular; greenish yellow	.19*
14-BB-25	do	27,530	32,340	2.0	.....	Light yellow; blowhole, #65, #40; broke at the neck	.01, .03
15-BB-25	do	26,800	56,600	15.0	20.8	Uniform light yellow	.13*, .12
16-BB-25	do	29,080	51,630	10.5	17.4	Light yellow; spongy spot	.09, .15*
17-BB-25	do	18,000	59,000	21.5	16.9	Light yellow; broke at the neck	.22, .21
18-BB-25	do	14,400	54,080	20.3	24.6	Light yellow	.20, .23*
19-BB-25	do	19.3	60,800	19.3	27.6	do	.20, .21*
20-BB-25	do	17,200	60,480	20.0	24.6	do	.18, .20, .19, .22*
15-BB-20	6" barrette carriage cradle liner	24,500	55,200	14.5	17.0	Uniform light yellow	.13, .16*
16-BB-20	do	24,400	53,980	18.5	17.5	Light yellow; oblique	.15, .22*
17-BB-20	do	25,950	48,100	9.5	16.2	Lavender yellow at circumference; golden yellow center	.11*, .08
18-BB-20	do	26,750	45,990	8.0	11.6	Light yellow	.07, .09*
19-BB-20	do	26,770	50,840	5.5	12.0	do	.07, .04
21-BB-20	do	25,950	49,190	8.0	10.1	Dark yellow; spongy spot at circumference	.06*, .08*
22-BB-20	do	22,500	61,200	14.7	16.9	Light yellow	.16*, .14, .14
1	6" barrette carriage recoil buffer	17,000	51,800	61.0	54.6	Uniform light yellow	.40, .62*

1	do	14,800	53,600	46.0	47.2	41.57*
2	do	15,200	51,900	52.5	49.0	.57*, 48
10	do	17,400	52,400	52.0	50.8	.58*, 46
11	do	35,600	61,600	41.0	60.8	.35, 29
13-AA-135	10" disappearing carriage, model 1901, bushing for counter recoil buffer.	18,400	56,120	43.5	42.0	44, .56*
4-AA-135	do	21,870	42,625	12.5	16.9	.10, .16*
4-AA-135	do	15,600	55,840	25.0	27.5	.23, .20*, 23
2-AA-135	do	18,800	60,080	48.5	41.9	.43*, 44*
22	12" disappearing carriage recoil buffer	28,690	90,200	8.0	.....	.06, .06

ALUMINIUM BRONZE.

Marks.	Description.	Rapid elongation per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
		Pounds	Pounds	Per cent.	Per cent.		Inch
	Experimental ingot	21,000	68,600	15.0	13.2	Uniform light yellow. Broke at the neck.	.15, .15
	Remelt of above	15,500	61,900	57.0	43.3	Uniform light yellow; oblique	.56, .62*

BRONZE FROM BUILDERS IRON FOUNDRY.

Mark.	Description.	Rapid elongation per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
		Pounds.	Pounds.	Per cent.	Per cent.		Inch.
1 P	For 6' barbette carriages.	35,000	22,200	8.0	6.8	Golden and light yellow and lavender.	.08, .08
2 P1	do	34,000	40,200	4.0	4.4	Lemon yellow and brown. Irregular.	.08, .06*
3 B4	do	34,000	62,400	17.5	18.6	Lemon yellow. Uniform.	.14, .21*
8 B4	do	36,000	58,600	7.0	9.2	Lemon yellow. Irregular surface.	.08*, .06
8 F3	do	35,800	35,800	2.5	4.4	Dark brown; yellow streak. Spongy.	.00, .06*
4 B2	do	34,000	64,600	14.5	18.6	Light yellow. Uniform.	.11, .19*
6 B2	do	32,000	61,400	16.5	14.0	Light yellow with dark patches. Irregular.	.11, .20*
6 B1	do	32,000	68,600	7.5	9.2	Light yellow; granular; brilliant facets.	.10*, .06
4 F2	do	29,000	4.0	4.0	4.4	Light and dark yellow; brown at center.	.07*, .01
5 F2	do	28,000	37,800	2.0	4.4	Dark yellow and brown intermingled.	.08*, .01
6 F2	do	20,000	39,600	3.5	6.8	Light and dark yellow; brown at center.	.01, .06*
7 F2	do	20,000	31,000	2.5	4.4	Dark yellow with golden yellow center.	.04*, .01
8 P1	do	19,000	38,400	4.5	6.8	Dark and golden yellow; brown patch at circumference.	.02, .07*
7 B4	do	24,000	67,200	19.5	23.0	Light yellow, lemon-yellow spots. Irregular.	.28*, .16
6 B1	do	30,000	70,400	11.0	16.2	Light yellow with bright facets.	.13*, .09
10 B4	do	21,000	67,800	19.0	20.8	Light yellow; irregular surface.	.21*, .17
9 B4	do	27,000	68,200	17.0	18.6	Light yellow with small lemon-yellow spots.	.23*, .14
11 B1	do	27,000	38,600	1.5	2.0	Light yellow; granular; spongy near circumference.	.02*, .01
11 P1	do	16,000	34,900	2.5	4.4	Light yellow, golden-yellow center. Fractured at spongy metal in thread.	.01, .04
10 P2	do	27,200	49,400	9.0	16.2	Light lavender and lemon yellow.	.12*, .06
12 B5	do	25,000	63,400	16.5	20.8	Light yellow.	.14, .19*
13 B2	do	31,200	69,800	16.0	18.6	Light yellow.	.19*, .13
9 P1	do	26,800	39,820	6.0	11.6	Light yellow; spongy at circumference.	.09*, .08
12 P1	do	21,800	35,080	4.0	9.2	Yellow and dark brown; spongy.	.01, .07*
13 P2	do	29,200	41,400	7.0	11.6	Light yellow with dark-brown spot.	.16*, .04
14 B2	do	30,200	42,200	9.1	11.6	Light yellow with lemon-yellow spots.	.16*, .06
13 P2	do	31,200	47,800	12.5	18.2	Light yellow; bright, radiant crystallization.	.02, .06*
15 B2	do	32,400	47,000	12.5	18.2	Light yellow; small, bright facets.	.17*, .09
13 B3	do	31,000	71,000	12.5	18.2	Light-golden yellow.	.18*, .13
17 B3	do	34,000	71,000	12.5	18.2	Light yellow.	.18*, .13
18 B3	do	32,000	62,800	20.5	20.8	Light yellow.	.17, .24*
18 B2	do	33,000	62,800	18.0	18.6	do.	.20*, .19
13 B1	do	32,000	65,800	14.0	18.6	do.	.08, .20*
20 B1	do	28,800	58,900	18.5	23.0	do.	.22*, .15
20 B1	do	28,000	47,600	11.0	14.0	Light and greenish yellow.	.10, .12*
17 P1	do	28,000	63,800	9.5	11.6	Light yellow; bright facets.	.08, .18*
18 P2	do	26,800	60,200	17.0	18.6	Light yellow.	.21*, .13
20 P2	do	26,800	64,840	17.0	18.6	Light yellow.	.06, .11*
21 P2	do	33,600	58,800	7.5	9.2	Light yellow; golden-yellow spots.	.10*, .05
21 P2	do	33,600	58,800	7.5	9.2	Light yellow; golden-yellow spots.	.10*, .05
1 B-T	do	20,400	53,640	58.5	62.2	Fine alloy.	.68*, .62*

BRONZE FROM ARCHIBALD WHEEL COMPANY.

Marks.	Description.	Rapid elongation per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
		<i>Pounds.</i>	<i>Pounds.</i>	<i>Per cent.</i>	<i>Per cent.</i>		<i>Inch.</i>
	75-millimeter mountain-gun carriage. Liner for wheel hub.	15,580	15,580	1.0	Inappreciable.	Granular, lemon yellow, brilliant facets.	.18, .21*
	do.	16,890	27,760	19.5	13.3	Uniform golden yellow.	.19, .24*
	do.	16,000	27,600	21.5	20.0	do.	.04, .12*
	do.	19,000	26,200	8.0	16.0	Light yellow and lavender colored.	.07, .09*
	Parsons' manganese bronze.	34,000	64,900	8.0	17.0	Light-yellow circumference, lemon-yellow center.	

No. 10583.

TENSILE TESTS OF BRONZE CASTINGS FROM ROCK ISLAND ARSENAL.

STEMS OF SPECIMENS UNFINISHED CASTINGS.

Mark on specimen.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 2 inches.	Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
			Total.	Per square inch.	Total.	Per square inch.					
3 B 142	<i>Inch.</i> 1.06	<i>Sq. inch.</i> .916	<i>Pounds.</i> 27,500	<i>Pounds.</i> 30,020	<i>Pounds.</i> 65,830	<i>Inch.</i> .47	<i>In. Sq. inch.</i> .96 = 724	<i>Per cent.</i> 21.0	Uniform light yellow.	" "	.22, .26
3 B 143	1.07	.899	24,200	26,920	68,300	.52	.92 = 665	26.0	do.	" "	.30*, .22
3 B 144	1.04	.849	24,500	28,860	67,840	.49	.90 = 686	25.1	do.	" "	.29*, .20
3 B 145	1.06	.892	25,100	28,460	70,630	.61	.92 = 665	24.6	do.	" "	.30, .31*
3 B 146	1.07	.899	27,000	30,080	68,520	.52	.91 = 650	27.7	do.	" "	.31*, .21

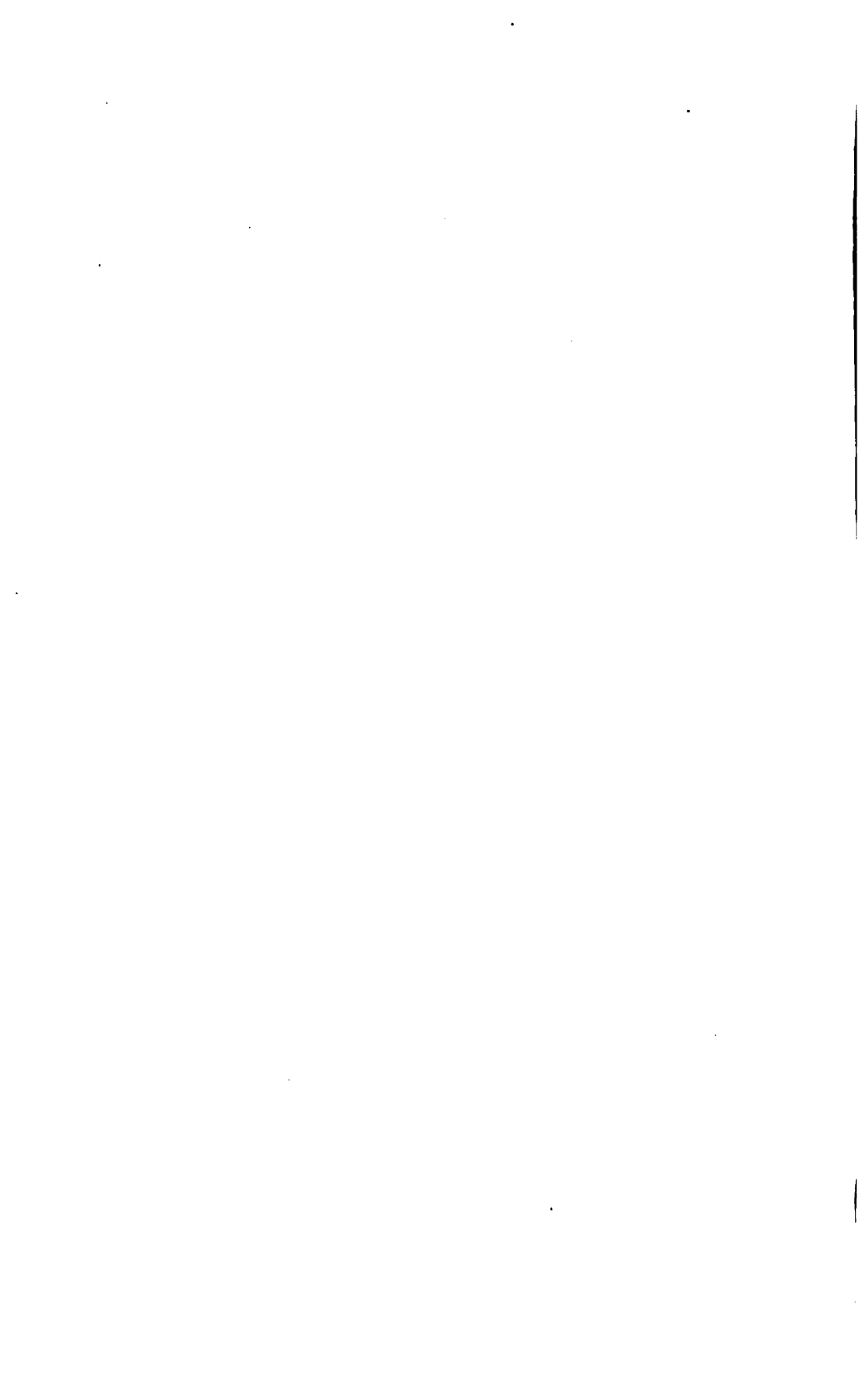
* Approximate.

COPPER EQUALIZING PIPES FOR 12-INCH DISAPPEARING CARRIAGES.

[Tests by interior hydrostatic pressures.]

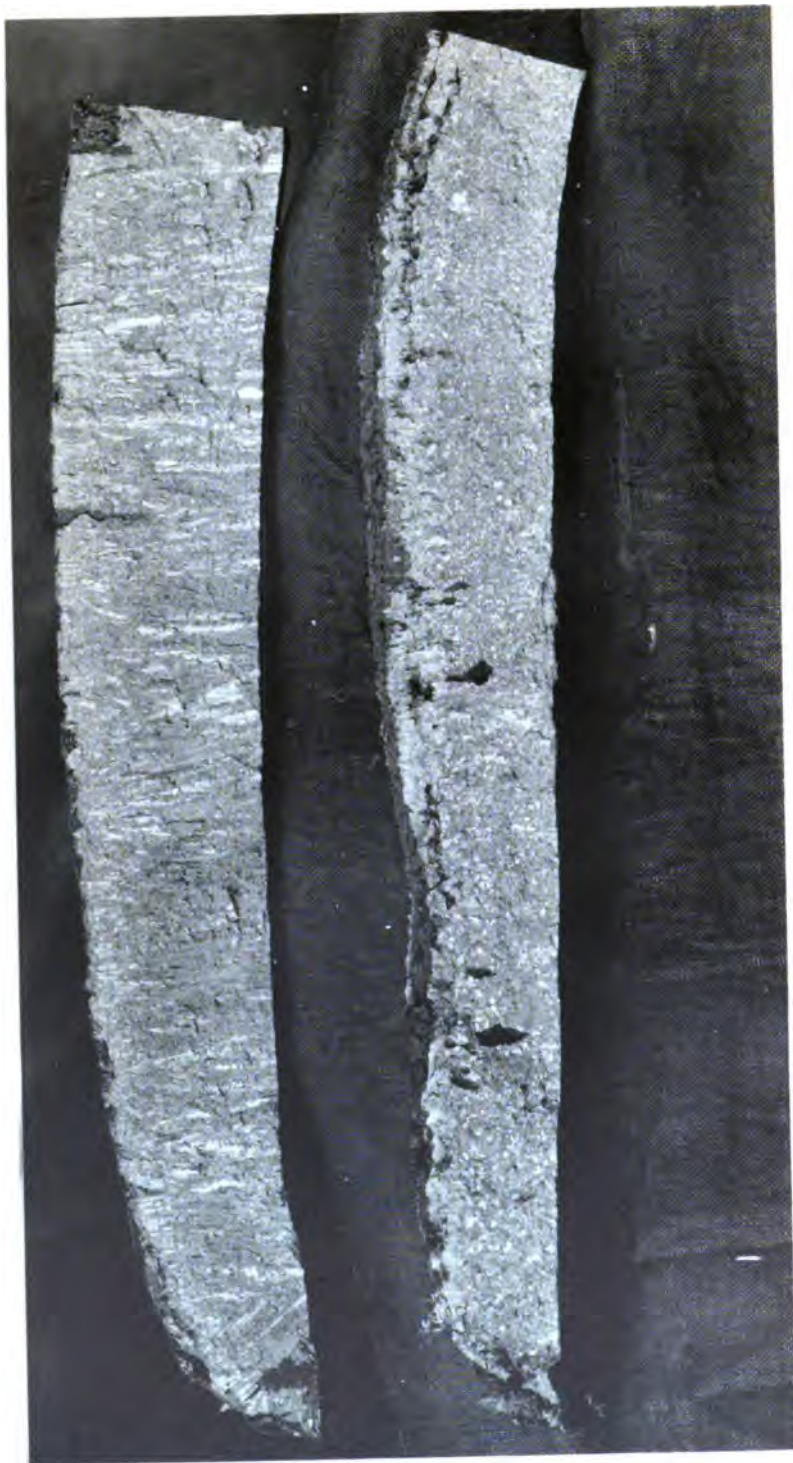
Description.	Dimensions.			Carriages manufactured by—	Interior bursting pressure per square inch.	Fractured.
	Diameters.		Thick-ness.			
	Interior.	Exterior.				
Pipe which had burst in a carriage at Fort H. G. Wright.	<i>Inch.</i> .890	<i>Inches.</i> 1.128	<i>Inch.</i> 0.121	The Bethlehem Steel Co....	<i>Pounds.</i> 4,126	Near coupling at end of pipe. Appearance, laminated. Opened short seams in five places.
Pipe from another carriage as above.....	.890	1.128	.121	.....do.....	5,694	Near coupling at end of pipe.
New section of pipe from Watertown arsenal storehouse.	.890	1.131	.121	.....do.....	7,821	Do.

CARBON AND NICKEL STEEL INGOTS.









SLABS FROM SIDES OF 16" BY 18" INGOTS.
APPEARANCE OF FRACTURES BY TRANSVERSE STRESSES OF NICKEL STEEL
AND CARBON STEEL.

HELLOTYPE CO. BOSTON.

CARBON AND NICKEL STEEL INGOTS.

TENSILE TESTS MADE ON UNFORGED BARS AFTER TREATMENT BY HEATING AND QUENCHING; ALSO TESTS ON BARS DRAWN DOWN UNDER THE HAMMER AT DIFFERENT TEMPERATURES.

CHEMICAL ANALYSES.

Carbon-steel ingot:	
Carbon .....	.20
Manganese .....	.58
Silicon .....	.015
Phosphorus .....	.017
Nickel-steel ingot:	
Carbon .....	.17
Manganese .....	.68
Silicon .....	.016
Phosphorus .....	.010
Nickel	8.25

In the details of the tests are recorded the expansions of the steel bars when taken from the heating furnace and immediately prior to being drawn down under the hammer. Initial measurements of their lengths were taken before heating and again when hot, the difference representing the expansion of the metal. Measurements on the hot bars are approximate, the formation of scale on the surfaces and the rapid change in temperature when withdrawn from the furnace preventing a more accurate determination of the expansion. The hot bars were taken at once to the hammer, where they were drawn down and finished with as little loss in temperature as practicable. The temperature color of the hot bars is given in each case.

METAL FROM 16" BY 18" CARBON-STEEL INGOT.

UNFORGED SPECIMENS AFTER HEAT TREATMENT OF THE STEEL.

No. 7627.

Heated to a straw color, cooled in dry sand.

Marks, C2, A'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	0.	
15,000	.0014	0.	
16,000	.0016	.....	Elastic limit.
17,000	.0018	.....
18,000	.0028	.....
19,000	.0048	.....
20,000	.0071	.0049	
21,000	.0090	.....
22,000	.0120	.....
24,000	.0198	.....
26,000	.0266	.....
28,000	.0340	.....
30,000	.0438	.0396	
32,000	.0530	.....
34,000	.0665	.....
36,000	.0788	.....
38,000	.0920	.....
40,000	.1070	.1015	
42,000	.13	.....
44,000	.15	.....
46,000	.19	.....
48,000	.21	.....
50,000	.26	.....
52,000	.32	.....
54,000	.46	.....	Tensile strength. = 16.3 per cent.
0	.46	.....

Elongation of inch sections, ".12, ".20*, ".16.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Appearance of fracture, granular, silvery luster.

No. 7628.

Heated to a blue, cooled in dry sand.
 Marks, C2, B'.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0008	0.	
15,000	.0012	0.	
18,000	.0014	.....	Elastic limit.
17,000	.0017	.....
18,000	.0028	.....
19,000	.0046	.....
20,000	.0072	.0050	
21,000	.0095	.....
22,000	.0140	.....
24,000	.0280	.....
25,000	.0365	.....
28,000	.0462	.....
33,000	.0570	.0525	
32,000	.0600	.....
34,000	.0659	.....
36,000	.0790	.....
38,000	.0928	.....
40,000	.1120	.1065	
42,000	.14	.....
44,000	.16	.....
46,000	.19	.....
48,000	.22	.....
50,000	.26	.....
52,000	.33	.....
54,000	.43	.....	Tensile strength.
0	.47	.....	= 15.7 per cent.

Elongation of inch sections, ".12, ".15, ".20*.
 Diameter at fracture, ".49; area, .1886 square inch.
 Contraction of area, 24.6 per cent.
 Appearance of fracture, granular, silvery luster.

No. 7629.

Heated first red (1,000° F. ±), cooled in dry sand.

Marks, C2, C'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
15,000	.0016	0.	
16,000	.0018	.....	Elastic limit.
17,000	.0019	.....
18,000	.0020	.....
19,000	.0021	.....
20,000	.0024	.0008	
21,000	.0030	.....
22,000	.0046	.....
23,000	.0070	.....
24,000	.0100	.....
26,000	.0173	.....
28,000	.0258	.....
30,000	.0343	.0303	
32,000	.0421	.....
34,000	.0528	.....
36,000	.0642	.....
38,000	.0780	.....
40,000	.0924	.0870	
42,000	.1060	.....
44,000	.14	.....
46,000	.16	.....
48,000	.18	.....
50,000	.21	.....
52,000	.25	.....
54,000	.33	.....
56,000	.44	.....
56,800	.....	.....	Tensile strength.
0	.51	.....	=17 per cent.

Elongation of inch sections, ".15, ".21*, ".15.

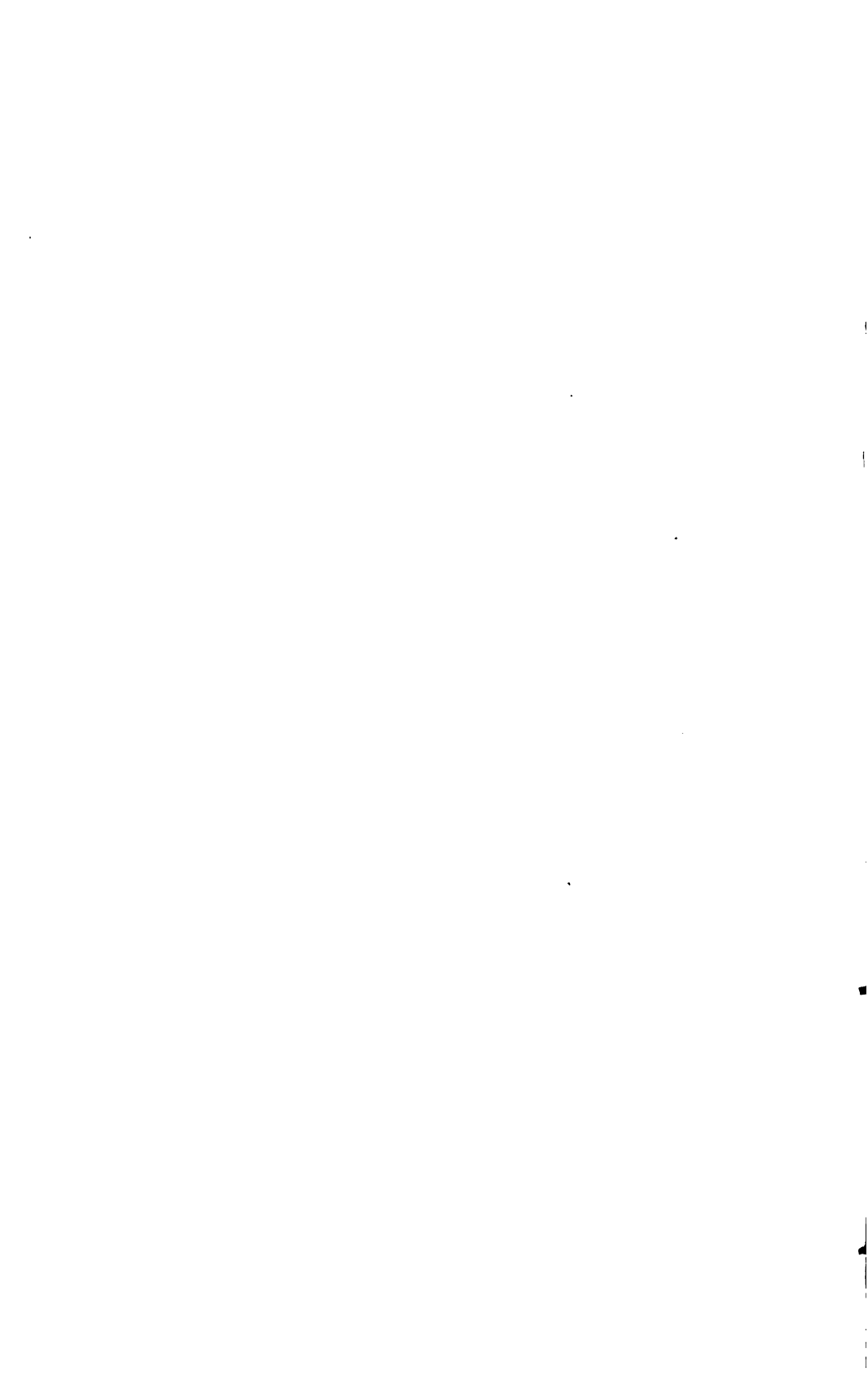
Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Appearance of fracture, granular, silvery luster.



**PHOTOMICROGRAPH OF STEM OF TENSILE 'SPECIMEN C2-C', NO. 7629, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 63 DIAMETERS.
STEEL HEATED FIRST RED AND COOLED IN DRY SAND.**



No. 7630.

Heated cherry red (1,150° F. ±), cooled in dry sand.
 Marks, C2-D'.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0014	0.	
16,000	.0017	.....
17,000	.0019	.....
18,000	.0020	.....	Elastic limit.
19,000	.0023	.....
20,000	.0084	.0011	
21,000	.0049	.....
22,000	.0070	.....
23,000	.0101	.....
24,000	.0128	.....
25,000	.0157	.....
26,000	.0207	.....
28,000	.0289	.....
30,000	.0381	.0342	
32,000	.0504	.....
34,000	.0672	.....
36,000	.0702	.....
38,000	.0880	.....
40,000	.0978	.0921	
42,000	.12	.....
44,000	.14	.....
46,000	.16	.....
48,000	.19	.....
50,000	.23	.....
52,000	.27	.....
54,000	.33	.....
56,000	.47	.....
56,400	.....	.....	Tensile strength.
0	.59	.....	=19.7 per cent.

Elongation of inch sections, ".23*", ".21", ".15.
 Diameter at fracture, ".50; area, .1964 square inch.
 Contraction of area, 21.4 per cent.
 Appearance of fracture, granular, silvery luster.

No. 7631.

Heated low yellow, cooled in dry sand.

Marks, C2, E'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0017	0.	
18,000	.0019	.....
17,000	.0020	.....
18,000	.0021	.....	Elastic limit.
19,000	.0024	.....
20,000	.0028	.0004	
21,000	.0081	.....
22,000	.0087	.....
23,000	.0089	.....
24,000	.0044	.....
25,000	.0049	.0018	
26,000	.0058	.....
27,000	.0059	.....
28,000	.0065	.....
29,000	.0075	.....
30,000	.0098	.0060	
32,000	.0220	.....
34,000	.0365	.....
36,000	.0446	.....
38,000	.0648	.....
40,000	.0650	.0596	
42,000	.0749	.....
44,000	.0870	.....
46,000	.1000	.....
48,000	.12	.....
50,000	.14	.....
52,000	.16	.....
54,000	.18	.....
56,000	.22	.....
58,000	.28	.....
59,920	.....	.....	Tensile strength.
0	.40	.....	=13.3 per cent.

Elongation of inch sections, ".12, ".10, ".18*.

Diameter at fracture, ".51; area, .2043 square inch.

Contraction of area, 18.3 per cent.

Appearance of fracture, granular, 50 per cent; dull amorphous, 50 per cent.

No. 7632.

Heated bright yellow, cooled in dry sand.

Marks, C2, F'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0008	0.		
10,000	.0009	0.		
15,000	.0014	0.		
20,000	.0020	0.		
25,000	.0025	0.		
30,000	.0031	0.		
35,000	.0037	0.		
40,000	.0041	0.		
41,000	.0043		Elastic limit.
42,000	.0047		Load fell.
38,000	.0090	.....	
39,000	.0132	.....	
40,000	.0550	.....	
41,000	.0580	.....	
42,000	.0619	.....	
43,000	.0658	.....	
44,000	.0717	.....	
46,000	.0820	.....	
48,000	.0940	.....	
50,000	.1095	.1028		
52,000	.13	.....	
54,000	.15	.....	
56,000	.17	.....	
60,000	.24	.....	
64,000	.38	.....	
65,380	Tensile strength.	
0	.55	=18.3 per cent.	

Elongation of inch sections, ".15, ".22*, ".18.

Diameter at fracture, ".48; area, .1810 square inch.

Contraction of area, 27.6 per cent.

Appearance of fracture, dull amorphous, oblique.

No. 7633.

Heated white hot, cooled in dry sand.

Marks, C2, G'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	0.	
15,000	.0016	0.	
20,000	.0020	0.	
25,000	.0026	0.	
30,000	.0031	0.	
35,000	.0038	0.	
36,000	.0040	.....	Elastic limit.
38,000	.0091	.....	Load fell.
34,000	.0240	.....
35,000	.0386	.....
36,000	.0368	.....
37,000	.0400	.....
38,000	.0432	.....
39,000	.0468	.....
40,000	.0525	.0470	
42,000	.0690	.....
44,000	.0712	.....
46,000	.0821	.....
48,000	.0933	.....
50,000	.1080	.1011	
52,000	.18	.....
54,000	.15	.....
56,000	.17	.....
60,000	.23	.....
64,000	.36	.....
65,520	.....	.....	Tensile strength.
0	.56	.....	= 18.3 per cent.

Elongation of inch sections, ".15, ".26*, ".14.

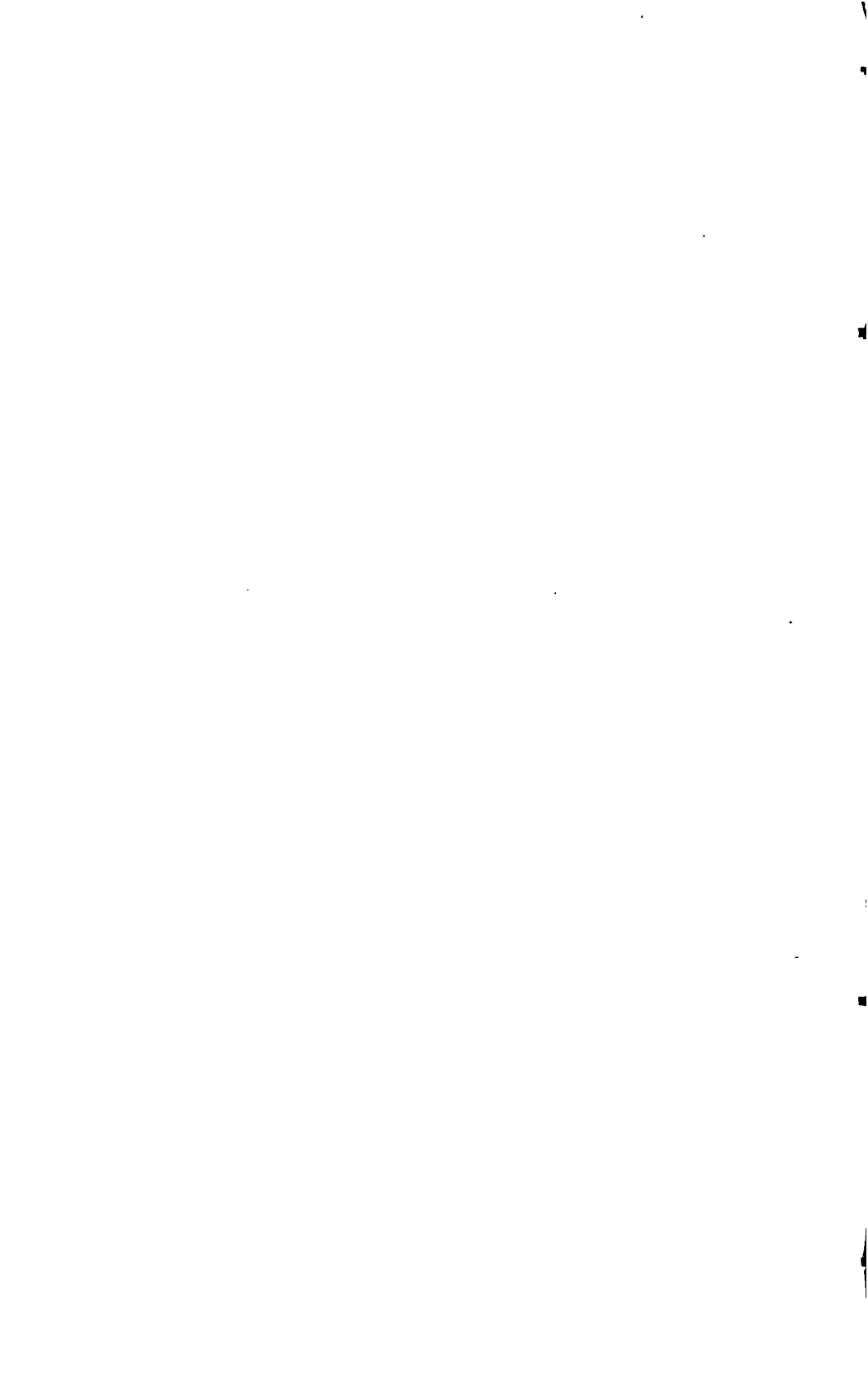
Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Appearance of fracture, dull amorphous, oblique.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C2-G, NO. 7633, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT AND COOLED IN DRY SAND.



No. 7634.

Scintillating heat, cooled in dry sand.

Marks, C2, H'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0008	0.		
10,000	.0010	0.		
15,000	.0015	0.		
20,000	.0021	0.		
24,000		Elastic limit.
25,000	.0080	.0008		
26,000	.0085	.....	
27,000	.0088	.....	
28,000	.0041	.....	
29,000	.0046	.....	
30,000	.0057	.0022		
31,000	.0068	.....	
32,000	.0111	.....	
33,000	.0120	.....	
34,000	.0168	.....	
35,000	.0192	.0150		
36,000	.0228	.....	
38,000	.0310	.....	
40,000	.0360	.0841		
42,000	.0470	.....	
44,000	.0560	.....	
46,000	.0685	.....	
48,000	.0782	.....	
50,000	.0958	.0691		
52,000	.12	.....	
54,000	.14	.....	
56,000	.16	.....	
60,000	.28	Tensile strength. = 18.7 per cent.	
64,000	.45	.....	
0	.56	.....	

Elongation of inch sections, ".19, ".25*, ".12.

Diameter at fracture, ".48; area, .1810 square inch.

Contraction of area, 27.6 per cent.

Appearance of fracture, dull amorphous.

No. 7635.

Heated white hot, quenched in oil.

Marks, C2, I'.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 3".

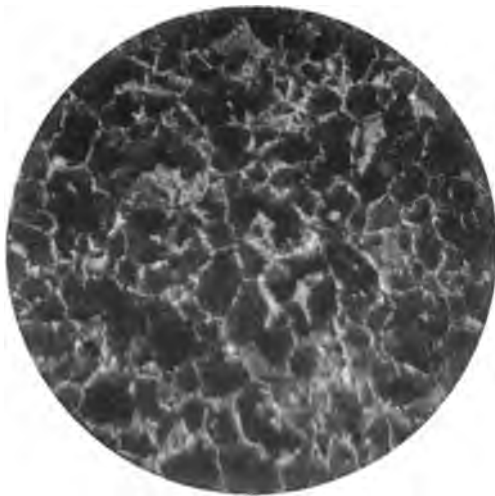
Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0005	0.	
10,000	.0011	0.	
15,000	.0016	0.	
20,000	.0020	0.	
25,000	.0025	0.	
30,000	.0033	0.	
35,000	.0040	.0001	
40,000	.0049	.0008	
45,000	.0059	.0010	
50,000	.0070	.0016	
55,000	.0087	.0027	
60,000	.0108	.0040	
65,000	.0140	.0065	
70,000	.0200	.0118	
75,000	.0320	.0227	
80,000	.0483	.0385	
85,000	.0691	.0682	
90,000	.10	.....
95,000	.14	.....
96,600	Tensile strength
0	.19	=6.3 per cent.

Elongation of inch sections, ".06, ".04, ".09*.

Diameter at fracture, ".47; area, .1735 square inch.

Contraction of area, 13.2 per cent.

Appearance of fracture, granular, 60 per cent; dull amorphous, 40 per cent.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C2-1, NO. 7635, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT AND QUENCHED IN OIL.



PHOTOMICROGRAPHS OF STEM OF TENSILE SPECIMEN C2-J', NO. 7636, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION OF EACH 53 DIAMETERS.
STEEL HEATED WHITE HOT AND QUENCHED IN BRINE.

No. 7636.

Heated white hot, quenched in brine.

Marks, C2, J'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0014	0.	
20,000	.0020	0.	
25,000	.0026	0.	
30,000	.0031	0.	
35,000	.0037	0.	
40,000	.0042	0.	
45,000	.0049	0.	
50,000	.0054	0.	
55,000	.0060	.0001	
60,000	.0067	.0001	
65,000	.0072	.0002	
70,000	.0079	.0003	
75,000	.0087	.0006	
80,000	.0093	.0008	
85,000	.0100	.0008	
90,000	.0107	.0009	
100,000	.02 -	-----	
110,000	.02 +	-----	
120,000	-----	-----	
0	.02	-----	Tensile strength. =0.7 per cent.

Elongation of inch sections, ".00, ".02*, ".00.

Diameter at fracture, ".56; area, .2463 square inch.

Contraction of area, 1.5 per cent.

Appearance of fracture, granular, radiating from a point in the circumference.

No. 7637.

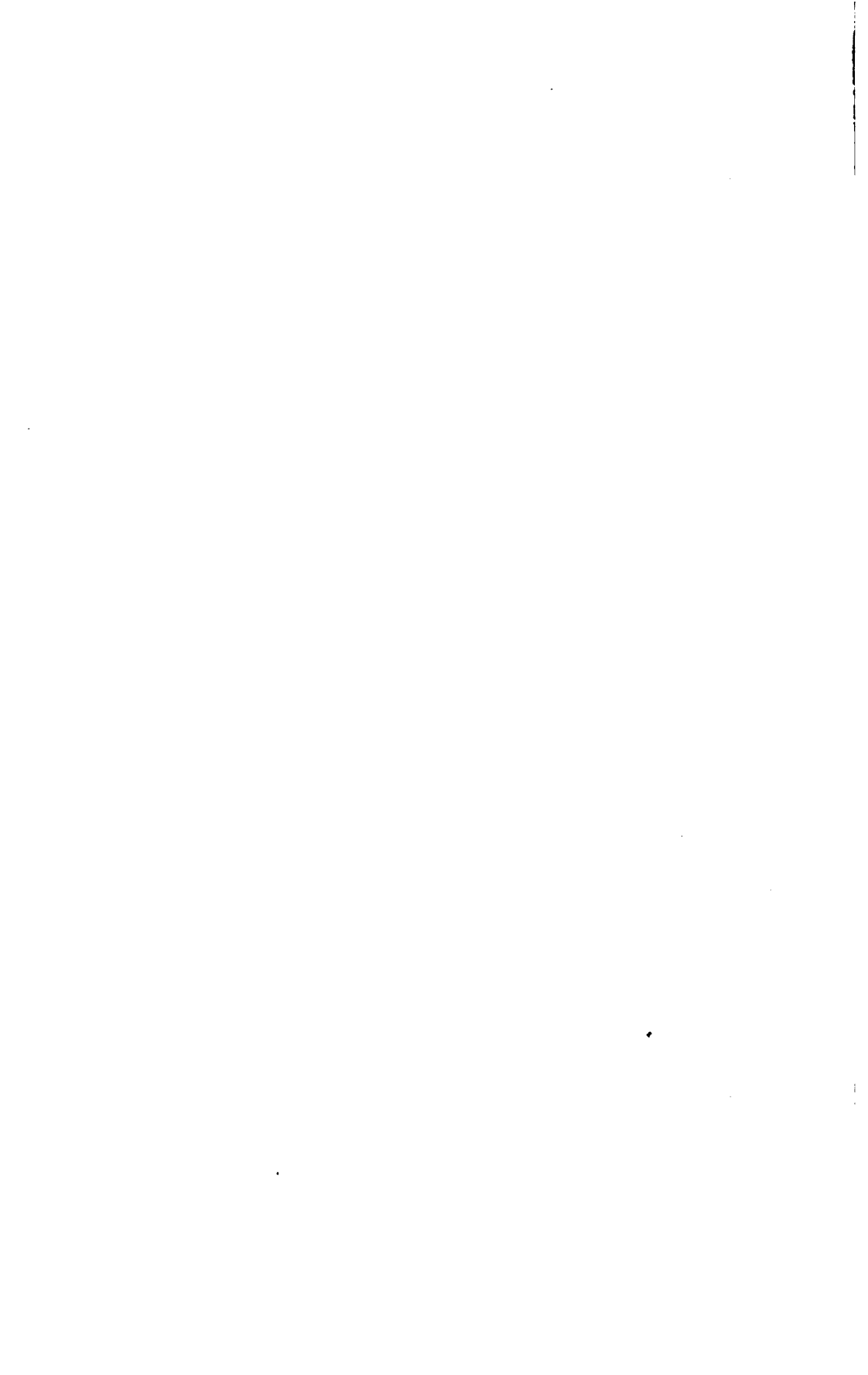
Heated white hot, quenched in oil, annealed at straw color.
 Marks, C2, K'.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0015	0.	
20,000	.0021	0.	
25,000	.0028	0.	
30,000	.0034	0.	
35,000	.0040	.0001	
40,000	.0050	.0006	
45,000	.0060	.0009	
50,000	.0068	.0011	
55,000	.0078	.0018	
60,000	.0090	.0023	
65,000	.0111	.0038	
70,000	.0122	.0043	
75,000	.0148	.0061	
80,000	.0186	.0092	
85,000	.0240	.0140	
90,000	.0342	.0232	
100,000	.07	.....
104,480	Tensile strength.
0	.12	=4 per cent.

Elongation of inch sections, ".08", ".02", ".02.
 Diameter at fracture, ".53; area, .2206 square inch.
 Contraction of area, 11.8 per cent.
 Appearance of fracture, granular.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C2-K', NO. 7637, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT, QUENCHED IN OIL.
AND ANNEALED AT STRAW COLOR.



No. 7638.

Heated white hot, quenched in oil, annealed at a blue heat.

Marks, C2, L'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0015	0.	
20,000	.0020	0.	
25,000	.0025	0.	
30,000	.0031	0.	
35,000	.0038	0.	
40,000	.0047	.0002	
45,000	.0054	.0007	
50,000	.0067	.0011	
55,000	.0084	.0024	
60,000	.0113	.0049	
65,000	.0162	.0089	
70,000	.0242	.0160	
75,000	.0349	.0259	
80,000	.0524	.0425	
85,000	.07	.....
90,000	.11	.....
91,760	.....	.....
0	.15	Tensile strength. = 5 per cent.

Elongation of inch sections, ".02, ".03, ".10*.

Diameter at fracture, ".52; area, .2124 square inch.

Contraction of area, 15 per cent.

Appearance of fracture, granular, dull amorphous spot at the circumference.

No. 7639.

Heated white hot, quenched in oil, annealed at cherry red.

Marks, C2, M'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	0.	
15,000	.0014	0.	
20,000	.0020	-.0001	
25,000	.0026	-.0001	
30,000	.0031	-.0001	
35,000	.0039	0.	
38,000	.0041	.....	Elastic limit.
39,000	.0147	.....
40,000	.0183	.0187	
41,000	.0209	.....
42,000	.0250	.....
43,000	.0290	.....
44,000	.0343	.....
45,000	.0381	.0328	
46,000	.0421	.....
47,000	.0468	.....
48,000	.0552	.....
49,000	.0607	.....
50,000	.0630	.0611	
52,000	.0802	.....
54,000	.0930	.....
56,000	.11	.....
60,000	.16	.....
64,000	.27	.....
65,280	.....	.....	Tensile strength.
0	.46	.....	=15.8 per cent.

Elongation of inch sections, ".07, ".12, ".27*.

Diameter at fracture, ".47; area, .1735 square inch.

Contraction of area, 30.6 per cent.

Appearance of fracture, dull amorphous, oblique.

No. 7640.

Heated white hot, quenched in oil, annealed at bright yellow.
 Marks C2, N'.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0009	0.		
15,000	.0014	0.		
20,000	.0020	0.		
25,000	.0026	0.		
30,000	.0032	0.		
35,000	.0039	0.		
36,000	.0041		Elastic limit. Load fell.
38,000	.0107	.....	
34,000	.0152	.....	
35,000	.0372	.....	
36,000	.0411	.....	
37,000	.0440	.....	
38,000	.0478	.....	
40,000	.0560	.0526		
42,000	.0698	.....	
44,000	.0789	.....	
46,000	.0920	.....	
48,000	.1080	.....	
50,000	.1209	.1188		
52,000	.15	.....	
54,000	.17	.....	
56,000	.20	.....	
58,000	.23	.....	
60,000	.28	.....	
62,000	.39	.....	
63,240	Tensile strength. =17.7 per cent.	
0	.58	.....	

Elongation of inch sections, ".15, ".15, ".23".
 Diameter at fracture, ".49; area, .1886 square inch.
 Contraction of area, 24.6 per cent.
 Appearance of fracture, dull amorphous, oblique, blowholes.

No. 7641.

Heated white hot, quenched in oil, annealed at white heat.

Marks, C2, O'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0014	0.	
20,000	.0020	0.	
25,000	.0028	.0001	
26,000	.0030	.....
27,000	.0031	.....
28,000	.0034	.....
29,000	.0037	.....
30,000	.0042	.0010	
31,000	.0057	.....
32,000	.0120	.....
33,000	.0208	.....
34,000	.0245	.....
35,000	.0259	.0225	
36,000	.0300	.....
38,000	.0390	.....
40,000	.0485	.0434	
42,000	.0580	.....
44,000	.0690	.....
46,000	.0798	.....
48,000	.0920	.....
50,000	.1096	.1030	
52,000	.13	.....
54,000	.16	.....
56,000	.19	.....
60,000	.26	.....
63,200	Tensile strength.
0	.47	=15.7 per cent.

Elongation of inch sections, ".21*", ".13, ".13.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Appearance of fracture, dull amorphous, oblique.

2.50

0.00

10.7632

1.00

"

"

"

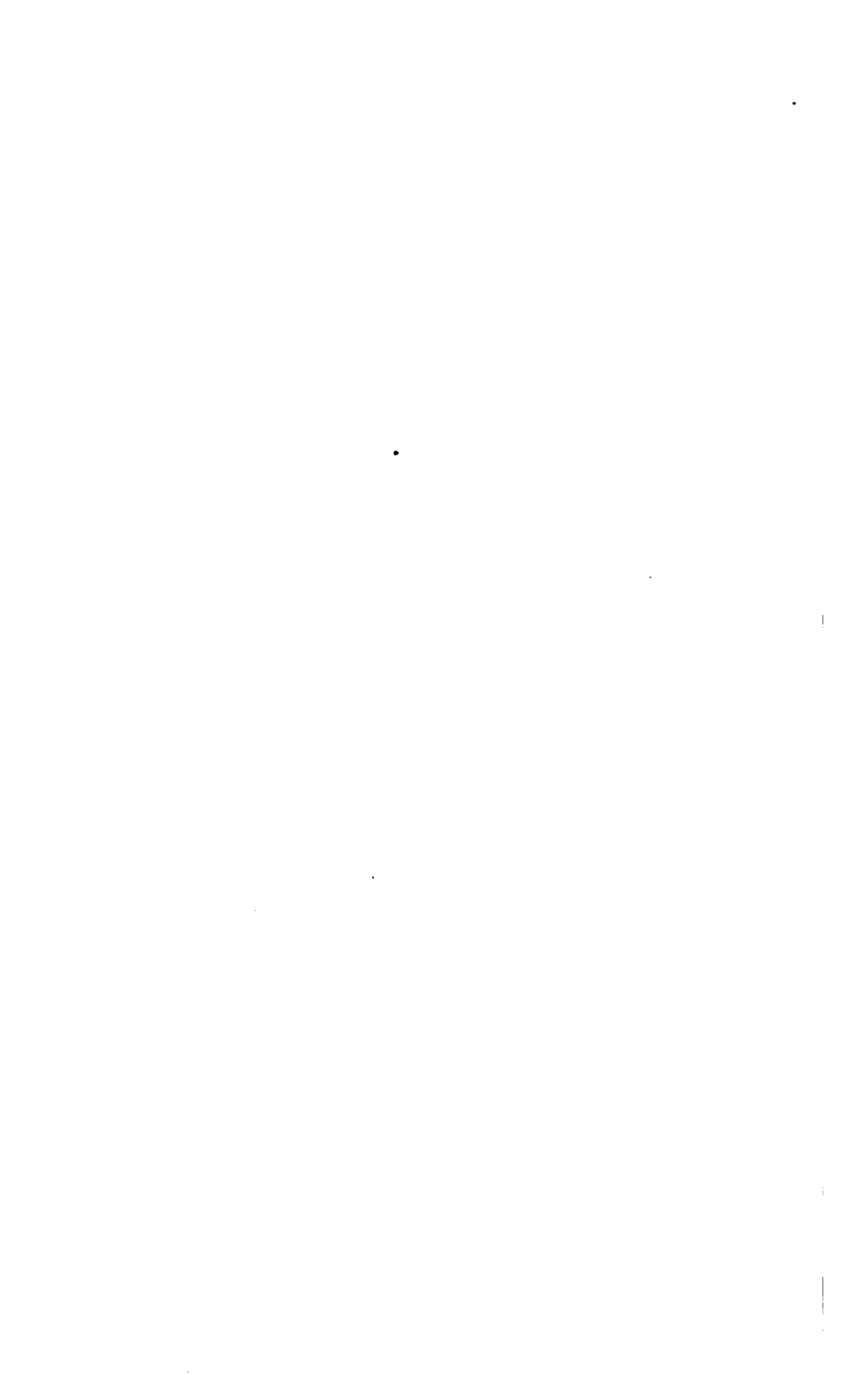


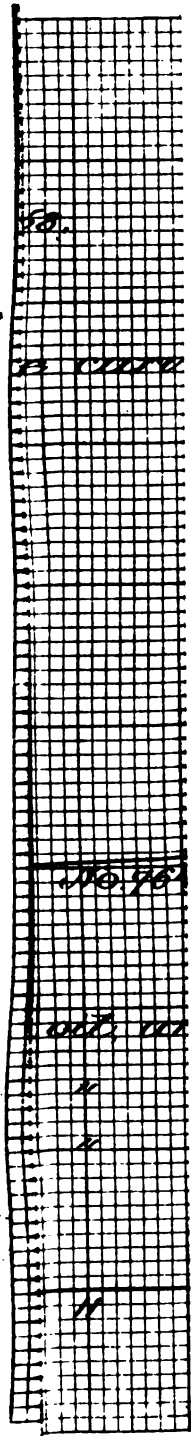
58.

70

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TABULATION OF TENSION SPECIMENS FROM 16" BY 18" CARBON STEEL INGOT.

UNFORGED SPECIMENS AFTER HEAT TREATMENT OF THE STEEL.

STEMS OF SPECIMENS, #564 DIAMETER, 3" LONG.

No. of test.	Treatment.	Elastic limit Per square inch.	Tensile strength Per square inch.	Elongation in 8 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
7627	Heated straw color, cooled in dry sand.	Pounds. 17,000	Pounds. 54,000	Per cent. 15.3	Per cent. 24.6	" "	
7628	Heated to a blue, cooled in dry sand.	16,000	54,000	17.7	24.6	.12, .20*, .16	Granular, silvery luster.
7629	Heated first red, cooled in dry sand.	19,000	56,800	17.9	21.4	.12, .15, .20*	Do.
7630	Heated cherry red, cooled in dry sand.	18,000	56,400	18.7	21.8	.20*, .21, .15	Do.
7631	Heated low yellow, cooled in dry sand.	18,000	59,220	18.8	18.8	.12, .10, .18*	Granular, 50 per cent; dull amorphous, 50 per cent.
7632	Heated bright yellow, cooled in dry sand.	41,000	65,860	18.8	27.6	.15, .22*	Dull amorphous, oblique.
7633	Heated white hot, cooled in dry sand.	36,000	61,500	18.8	24.8	.15, .26*, .14	Do.
7634	Scorching heat, cooled in dry sand.	24,000	64,000	18.7	27.6	.19, .26*, .13	Dull amorphous.
7635	Heated white hot, quenched in oil.	(c)	95,600	6.8	b13.2	.06, .04, .09*	Granular, 50 per cent; dull amorphous, 40 per cent.
7636	Heated white hot, quenched in brine.	(a)	120,000	0.7	1.5	.00, .02*	Granular, radiating from point in circumference.
7637	Heated white hot, quenched in oil, and annealed at straw color.	(a)	104,400	4.0	11.8	.08*, .02, .02	Granular.
7638	Heated white hot, quenched in oil, and annealed at blue heat.	(a)	91,760	5.0	15.0	.02, .08, .10*	Granular; dull amorphous spot at circumference.
7639	Heated white hot, quenched in oil, and annealed at cherry red.	38,000	65,280	15.8	30.6	.07, .12, .27*	Dull amorphous, oblique.
7640	Heated white hot, quenched in oil, and annealed at bright yellow.	36,000	63,240	17.7	24.6	.15, .15, .23*	Dull amorphous, oblique, blow holes.
7641	Heated white hot, quenched in oil, and annealed at white heat.	(a)	63,200	15.7	24.6	.21*, .18, .13	Dull amorphous, oblique.

a Indefinite.

b Diameter of stem, #506.

METAL FROM 16" BY 18" CARBON STEEL INGOT.

FORGED SPECIMENS—SQUARE BARS DRAWN DOWN TO ROUNDS AT DIFFERENT TEMPERATURES.

Original dimensions of specimens: 1".28 × 1".28 × 7".22 long.

No. 7773.

Heated to a low yellow (expansion, ".075 in 7".22), and drawn down under the hammer, finishing at black heat. Reduction, 46.3 per cent.

Cooled in the air.

Marks, C6-1.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
20,000	.0020	0.	
30,000	.0030	0.	
40,000	.0039	0.	
50,000	.0049	0.	
60,000	.0059	0.	
70,000	.0069	0.	
80,000	.0082	.0002		Elastic limit.
81,000	.0090	0.	
82,000	.0195	0.	
83,000	.0228	0.	
84,000	.0320	0.	
85,000	.0365	.0269	
86,000	.0390	0.	
87,000	.0450	0.	
88,000	.0625	0.	
89,000	.08	0.	
90,000	.10	0.	Tensile strength. = 7.7 per cent.
90,480	.23	0.	

Elongation of inch sections, ".03, ".04, ".16.*

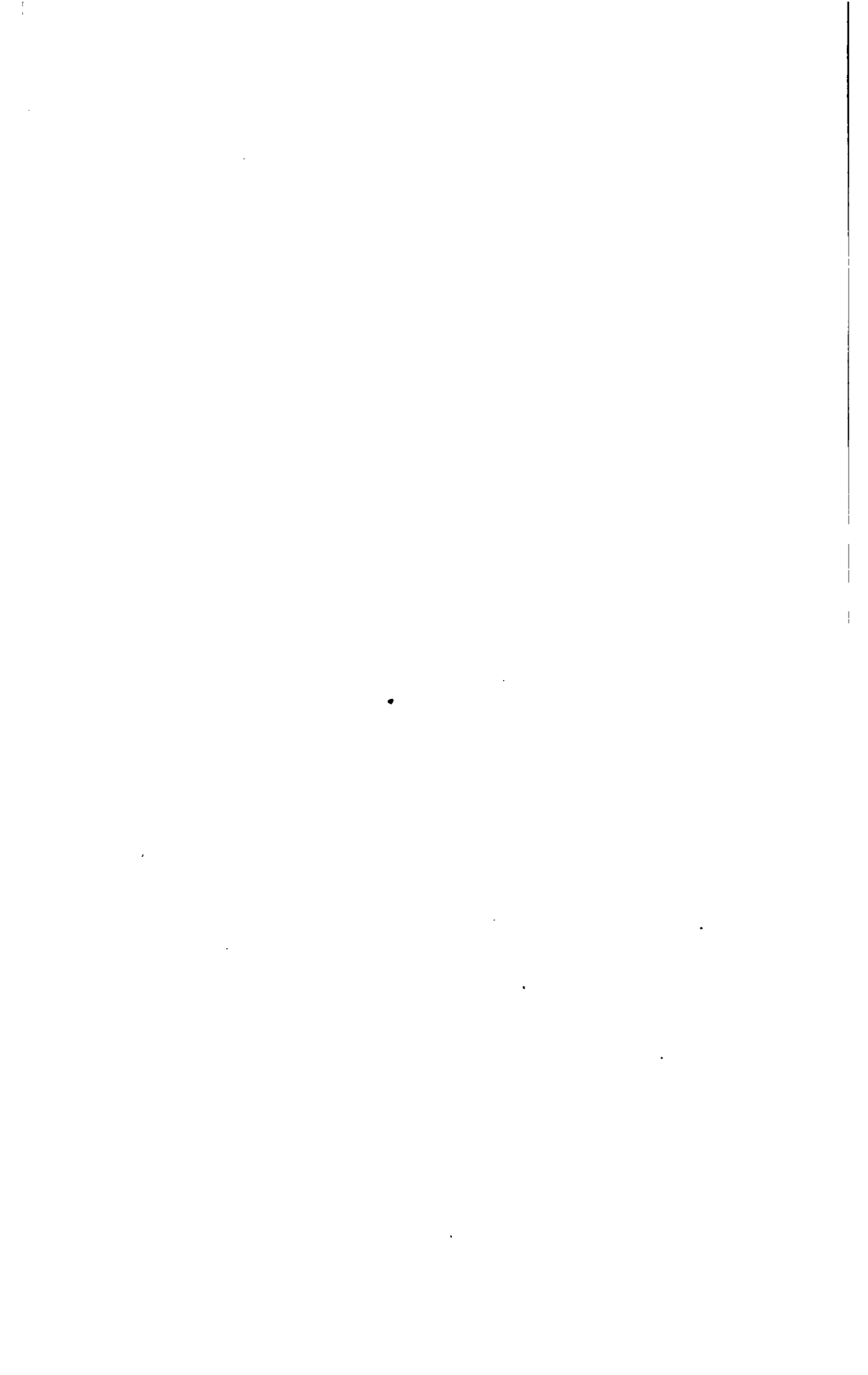
Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Appearance of fracture, silky, irregular surface.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-1, NO. 7773, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED LOW YELLOW AND DRAWN DOWN UNDER THE HAMMER
AT BLACK HEAT. COOLED IN AIR.





PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-2, NO. 7774, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED FULL YELLOW AND DRAWN DOWN UNDER THE HAMMER
AT BRIGHT RED. COOLED IN AIR.

No. 7774.

Heated to a full yellow (expansion, ".089 in 7".22), and drawn down under the hammer at bright red. Reduction, 32.3 per cent.

Cooled in the air.

Marks, C6-2.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load	
5,000	.0008	0.		
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	0.		
35,000	.0036	0.		
40,000	.0041	0.		
45,000	.0048	.0001		
46,000	.0050		Elastic limit. Load fell.
39,000	.0119	.....	
40,000	.0174	.....	
41,000	.0225	.....	
42,000	.0285	.....	
43,000	.0370	.....	
44,000	.0486	.....	
46,000	.0690	.....	
48,000	.1010	.....	
50,000	.1180	.1110		
52,000	.13	.....	
54,000	.16	.....	
56,000	.19	.....	
58,000	.22	.....	
60,000	.26	.....	
62,000	.33	.....	
64,000	.43	.....	
64,960	Tensile strength. = 31 per cent.	
0	.93	.....	

Elongation of inch sections, ".21, ".50*, ".21.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Appearance of fracture, silky.

No. 7775.

Heated to a bright yellow (expansion, ".103 in 7".22), and drawn down under the hammer at full yellow. Reduction, 33.5 per cent.

Cooled in the air.

Marks, C6-3.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

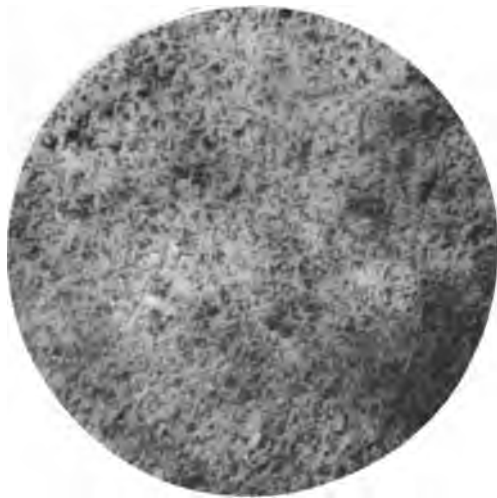
Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	0.		
40,000	.0040	0.		
40,800		Elastic limit. Load fell.
35,000	.0118	.....	
36,000	.0180	.....	
37,000	.0300	.....	
38,000	.0400	.....	
39,000	.0580	.....	
40,000	.0560	.0509		
42,000	.0645	.....	
44,000	.0740	.....	
46,000	.0885	.....	
48,000	.0990	.....	
50,000	.1170	.1102		
52,000	.14	.....	
54,000	.16	.....	
56,000	.19	.....	
58,000	.22	.....	
60,000	.26	.....	
64,000	.44	.....	
65,520	Tensile strength.	
0	.72	= 24 per cent.	

Elongation of inch sections, ".37*", ".21, ".14.

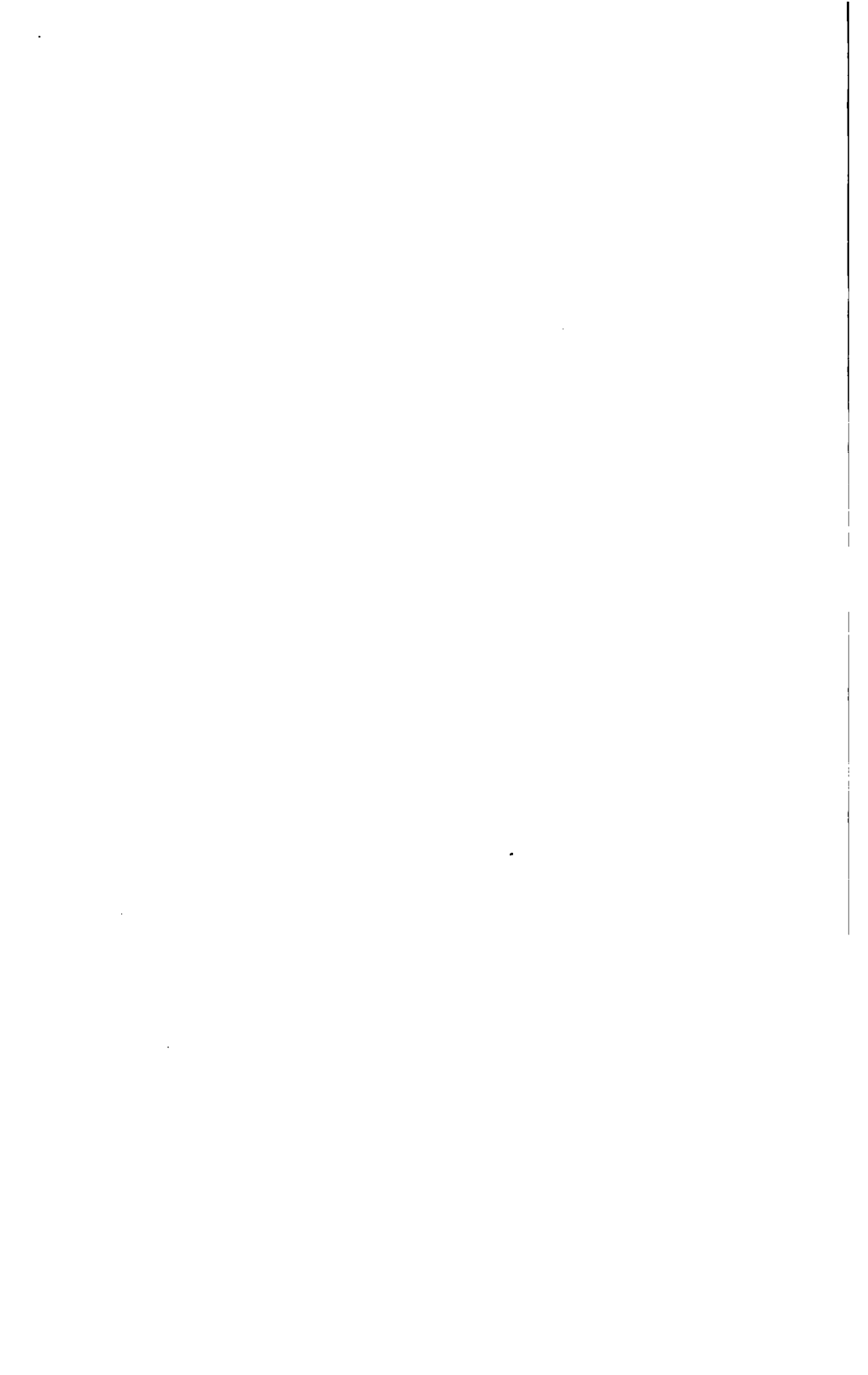
Diameter at fracture, ".44; area, .1521 square inch.

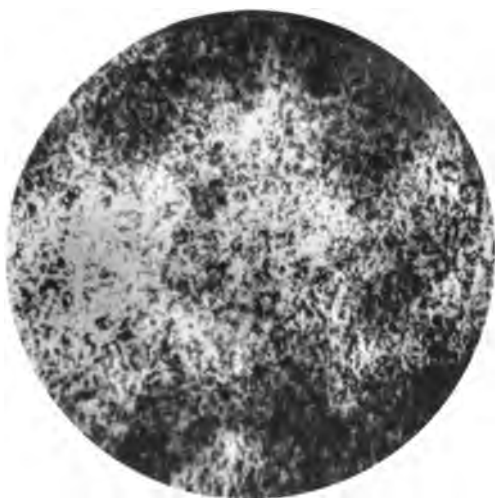
Contraction of area, 39.2 per cent.

Appearance of fracture, silky; spot of lighter colored metal, ".06 diameter.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-3, NO. 7775, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BRIGHT YELLOW AND DRAWN DOWN UNDER THE HAMMER
AT FULL YELLOW. COOLED IN AIR.





PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-4, NO. 7776, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED LOW WHITE AND DRAWN DOWN UNDER THE HAMMER
AT BRIGHT LEMON. COOLED IN AIR.

No. 7776.

Heated to a low white (expansion, ".121 in 7".22), and drawn down under the hammer at bright lemon. Reduction, 32.3 per cent.

Cooled in the air.

Marks, C6-4.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0080	0.	
35,000	.0085	0.	Elastic limit. Load fell.
36,000	.0087	.....
34,000	.0065	.....
35,000	.0079	.....
36,000	.0098	Load fell, second time.
37,000	.0120	.....
38,000	.0251	.....
34,000	.0262	.....
35,000	.0284	Load fell, third time.
36,000	.0885	.....
37,000	.0885	.....
35,000	.0420	.....
36,000	.0429	.....
37,000	.0438	.....
38,000	.0460	.....
39,000	.0491	.....
40,000	.0650	.0600	
42,000	.0620	.....
44,000	.0740	.....
46,000	.0860	.....
48,000	.0990	.....
50,000	.1165	.1098	
52,000	.14	.....
54,000	.16	.....
56,000	.19	.....
58,000	.22	.....
60,000	.27	.....
62,000	.32	.....
64,000	.44	.....
64,800	Tensile strength.
0	.68	=22.7 per cent.

Elongation of inch sections, ".42*", ".15", ".11.

Diameter at fracture, ".40; area, .1257 square inch.

Contraction of area, 49.7 per cent.

Appearance of fracture, silky.

No. 7777.

Heated to a full cherry (expansion, ".069 in 7."22), and drawn down under the hammer at nearly the same temperature. Reduction, 20.1 per cent.

Cooled in the air.

Marks, C6-5.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3."

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0030	0.	
35,000	.0035	0.	
40,000	.0040	0.	
45,000	.0046	0.	
48,000	.0049	.....
48,800	.....	.....		Elastic limit. Load fell.
42,000	.0140	.....
43,000	.0531	.....
44,000	.0620	.....
44,000	.0768	.....
45,000	.0803	.....
46,000	.0860	.....
47,000	.0885	.....
48,000	.0970	.....
48,000	.1040	.....
50,000	.1110	.1040	
52,000	.13	.....
54,000	.15	.....
56,000	.18	.....
58,000	.21	.....
60,000	.25	.....
62,000	.30	.....
64,000	.42	.....
0	.52	Tensile strength. =17.3 per cent.

Elongation of inch sections, ".21,* ".20,* ".11.

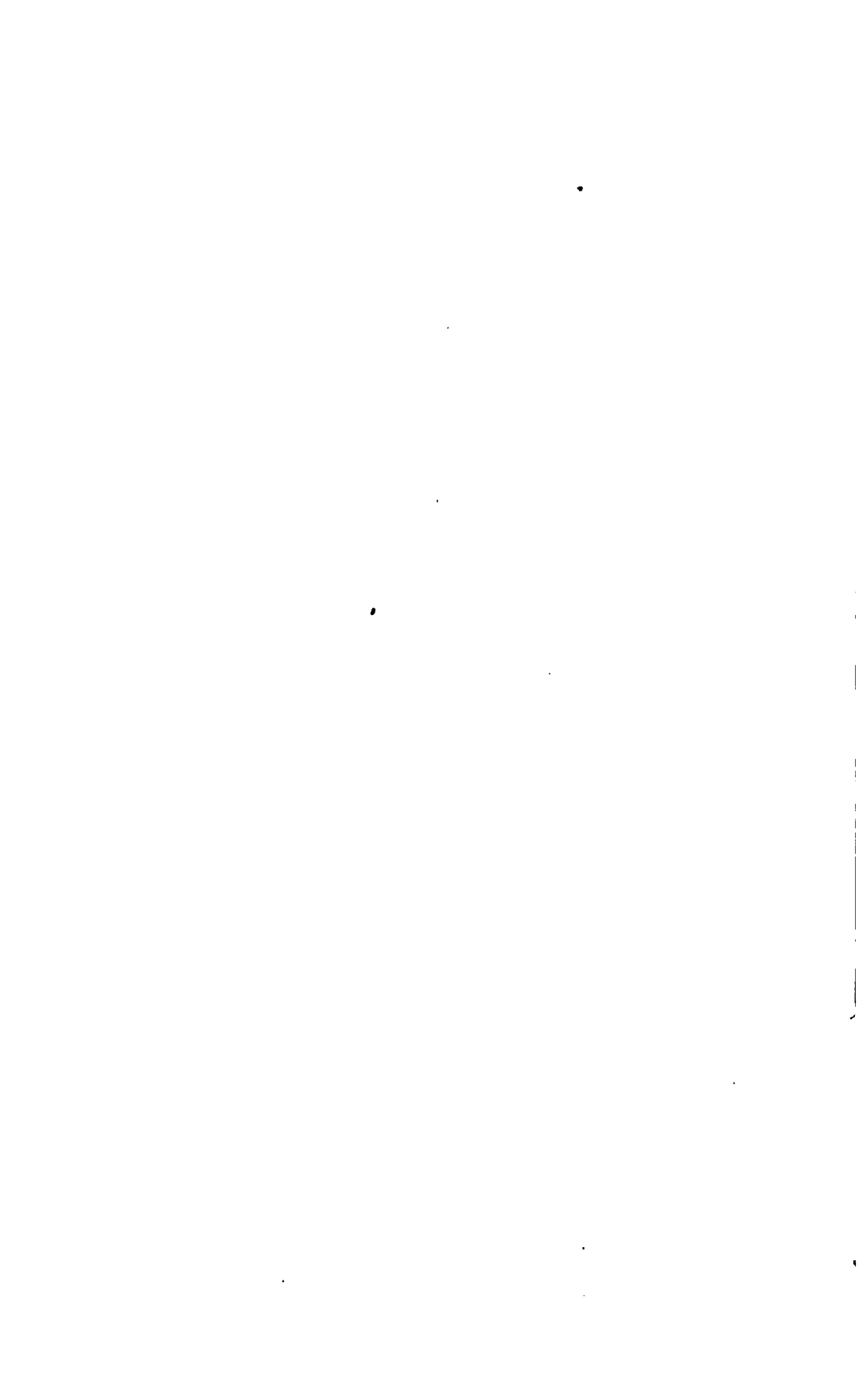
Diameter at fracture, ".48; area, .1810 square inch.

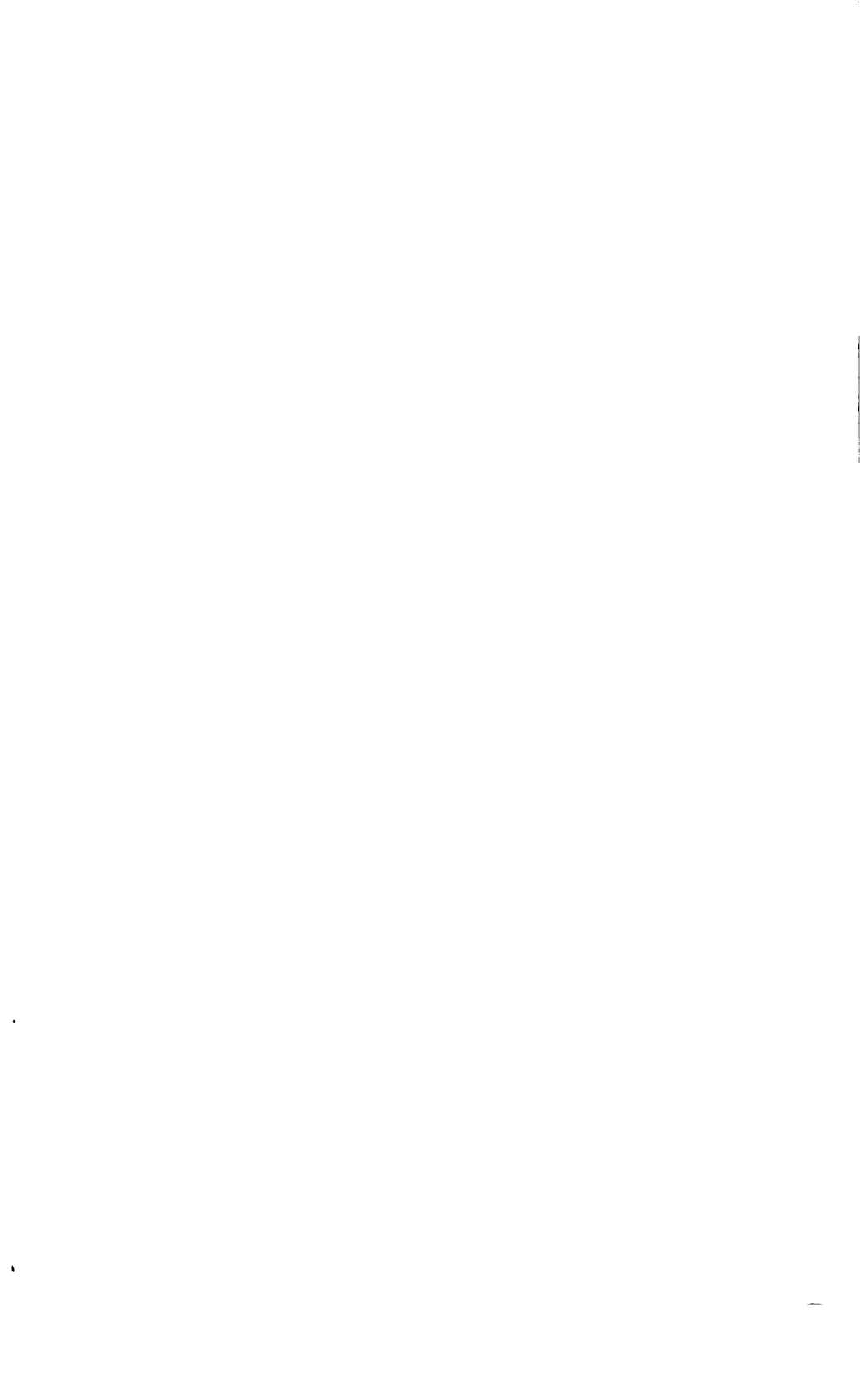
Contraction of area, 27.6 per cent.

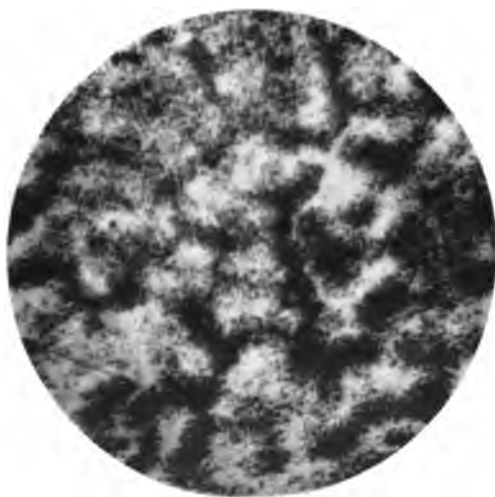
Appearance of fracture, silky, oblique.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-5, NO. 7777, CROSS SECTION
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED FULL CHERRY AND DRAWN DOWN UNDER THE HAMMER
AT NEARLY THE SAME TEMPERATURE. COOLED IN AIR.







PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-6, NO. 7778, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED LOW CHERRY AND DRAWN DOWN UNDER THE HAMMER
AT NEARLY THE SAME TEMPERATURE. COOLED IN AIR.

No. 7778.

Heated to a low cherry (expansion, ".057 in 7".23), and drawn down under the hammer at nearly the same temperature. Reduction, 23.8 per cent.

Cooled in the air.

Marks, C6-6.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0080	0.	
35,000	.0084	0.	
40,000	.0040	0.	
45,000	.0046	0.	
49,000	.0051	.....
43,000	.0120	.....		Elastic limit. Load fell.
44,000	.0221	.....
45,000	.0397	.....
46,000	.0500	.....
47,000	.0760	.....
48,000	.0810	.....
49,000	.0851	.....
50,000	.0935	.0861	
52,000	.10	.....
54,000	.12	.....
56,000	.15	.....
58,000	.18	.....
60,000	.22	.....
62,000	.25	.....
64,000	.31	.....
66,000	.48	.....
66,400	Tensile strength. =25 per cent.
0	.75	.....

Elongation of inch sections, ".20, ".38*, ".17.

Diameter at fracture, ".42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, silky.

No. 7779.

Heated to a blood red (expansion, ".069 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 16.5 per cent.

Cooled in the air.

Marks, C6-7.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	-----	
20,000	.0021	-----	
30,000	.0031	0.	
34,000	-----	-----	Elastic limit, approximate.
36,000	.0042	-----	
37,000	.0048	-----	
38,000	.0058	-----	
39,000	.0070	-----	
40,000	.0082	.0050	
41,000	.0100	-----	
42,000	.0140	-----	
43,000	.0181	-----	
44,000	.0210	-----	
45,000	.0240	.0190	
46,000	.0275	-----	
48,000	.0420	-----	
50,000	.0558	.0498	
52,000	.0650	-----	
54,000	.0840	-----	
56,000	.1080	-----	
58,000	.1350	-----	
60,000	.20	-----	
61,200	-----	-----	Tensile strength.
0	.32	-----	=10.7 per cent.

Elongation of inch sections, ".20*", ".08, ".04.

Diameter at fracture, ".49; area, .1886 square inch.

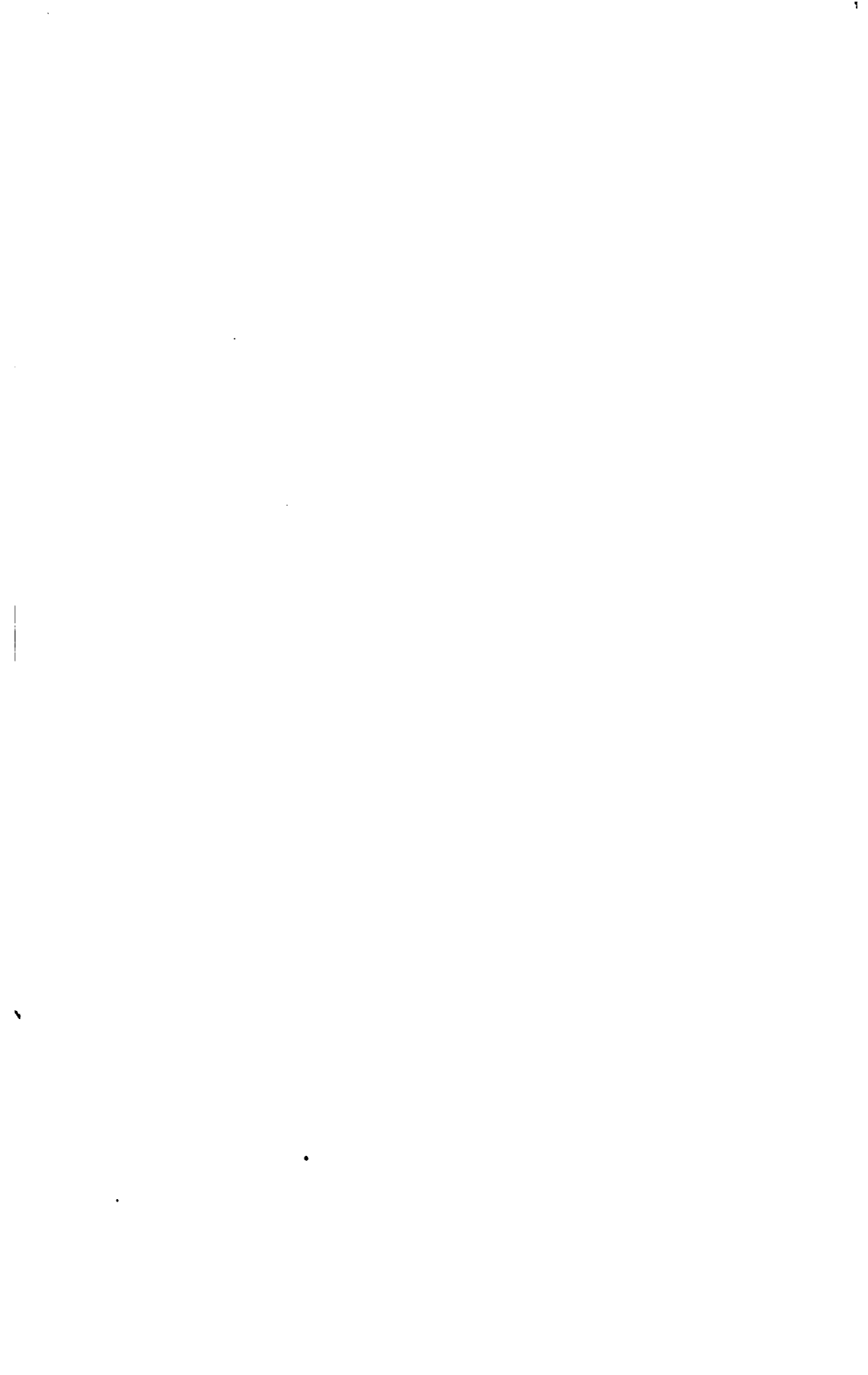
Contraction of area, 24.6 per cent.

Appearance of fracture, gray amorphous, oblique.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-7, NO. 7779, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BLOOD RED AND DRAWN DOWN UNDER THE HAMMER
AT NEARLY THE SAME TEMPERATURE. COOLED IN AIR.







PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-8, NO. 7780, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BLOOD RED AND DRAWN DOWN UNDER THE HAMMER
AT NEARLY THE SAME TEMPERATURE. COOLED IN AIR.

No. 7780.

Heated to a blood red (expansion ".072 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 43.9 per cent.

Cooled in the air.

Marks, C6-8.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	
20,000	.0020	
30,000	.0030	0.	Elastic limit.
35,000	.0035	0.	
39,000	.0040	.....
40,000	.0045	.0006	
41,000	.0051	.....
42,000	.0060	.....
43,000	.0072	.....
44,000	.0106	.....
45,000	.0150	.0101	
46,000	.0198	.....
47,000	.0255	.....
48,000	.0315	.....
49,000	.0393	.....
50,000	.0470	.0410	
52,000	.0585	.....
54,000	.0758	.....
56,000	.0900	.....
58,000	.1140	.....
60,000	.1380	.1301	
62,000	.18	.....
64,000	.24	.....
65,200	Tensile strength.
0	.54	=18 per cent.

Elongation of inch sections, ".37*", ".11, ".06.

Diameter at fracture, ".40; area, .1257 square inch.

Contraction of area, 49.7 per cent.

Appearance of fracture, silky.

No. 7781.

Heated to a blood red (expansion, ".057 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 31.1 per cent.

Cooled in the air.

Marks, C6-9.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0004	0.		
10,000	.0010	0.		
20,000	.0021	0.		
30,000	.0031	0.		
35,000	.0035	0.		
40,000	.0040	0.		
45,000	.0045	0.		
50,000	.0052	.0002		Elastic limit.
51,000	.0056	0.		
52,000	.0060	0.		
53,000	.0063	0.		
54,000	.0070	0.		
55,000	.0080	.0024		
56,000	.0090	0.		
57,000	.0120	0.		
58,000	.0162	0.		
59,000	.0198	0.		
60,000	.0270	.0202	Tensile strength. =9 per cent.	
62,000	.0370	0.		
64,000	.0520	0.		
66,000	.0620	0.		
68,000	.0740	0.		
70,000	.10	0.		
72,000	.12	0.		
74,000	.16	0.		
74,880	.27	0.		
0	.27	0.		

Elongation of inch sections, ".07, ".16*, ".04.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Appearance of fracture, dull silky.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-9, NO. 7781, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BLOOD RED AND DRAWN DOWN UNDER THE HAMMER
AT NEARLY THE SAME TEMPERATURE. COOLED IN AIR.

No. 7782.

Heated to a bright red (expansion, ".061 in 7".22), and drawn down under the hammer at full red. Reduction, 43.9 per cent.

Quenched in water.

Marks, C6-10.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0029	0.	
40,000	.0039	0.	
50,000	.0049	0.	
55,000	.0056	0.	
60,000	.0065	.0008	Elastic limit.
61,000	.0068	.....
62,000	.0071	.....
63,000	.0076	.....
64,000	.0080	.....
65,000	.0092	.0021	
66,000	.0139	.....
67,000	.0240	.....
68,000	.0310	.....
69,000	.0360	.....
70,000	.0390	.0300	
72,000	.0450	.....
74,000	.0520	.....
76,000	.0585	.....
78,000	.0660	.....
80,000	.0763	.0652	
84,000	.10	.....
88,000	.13	.....
92,000	.18	.....
96,000	.28	.....
96,480	.48	.....	Tensile strength. = 16 per cent.

Elongation of inch sections, ".11, ".27*, ".10.

Diameter at fracture, ".47; area, .1735 square inch.

Contraction of area, 30.6 per cent.

Appearance of fracture, dull silky, irregular, oblique.

No. 7783.

Heated to a yellow (expansion, ".079 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 42.1 per cent.

Quenched in water.

Marks, C6-11.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0030	Elastic limit.
40,000	.0040	0.	
50,000	.0050	0.	
53,000	.0054	.....
54,000	.0057	.....
55,000	.0060	.0008	
56,000	.0065	.....
57,000	.0069	.....
58,000	.0072	.....
59,000	.0075	.....
60,000	.0080	.0016	
62,000	.0092	.....
64,000	.0119	.....
66,000	.0168	.....
68,000	.0215	.....
70,000	.0252	.0180	
72,000	.0305	.....
74,000	.0360	.....
76,000	.0425	.....
78,000	.0480	.....
80,000	.0560	.0476	
84,000	.08	.....
88,000	.10	.....
92,000	.13	.....
96,000	.18	.....
98,480	Tensile strength. =17 per cent.
0	.51	.....

Elongation of inch sections, ".08, ".32*, ".11.

Diameter at fracture, ".40; area, .1257 square inch.

Contraction of area, 49.7 per cent.

Appearance of fracture, silky.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-11, NO. 7783, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED YELLOW AND DRAWN DOWN UNDER THE HAMMER
AT NEARLY THE SAME TEMPERATURE. QUENCHED IN WATER.

No. 7784.

Heated to a bright yellow (expansion, ".097 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 43.3 per cent.

Quenched in water.

Marks, C6-12.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

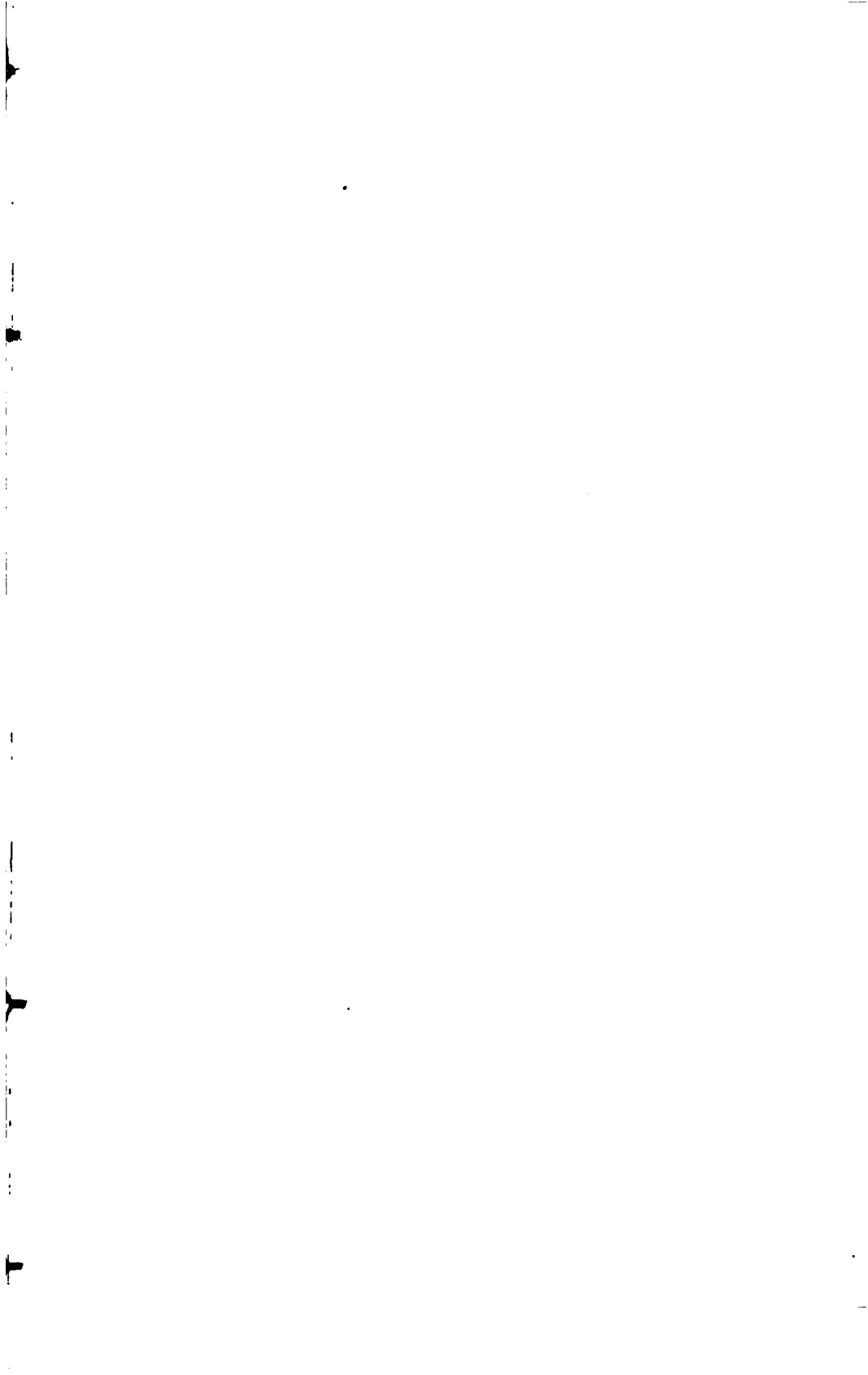
Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	.....
40,000	.0040	0.	
45,000	.0047	.0001	
46,000	.0049	.....
47,000	.0050	.....
48,000	.0052	.....		Elastic limit, approximate.
49,000	.0055	.....
50,000	.0058	.0007	
51,000	.0060	.....
52,000	.0063	.....
53,000	.0065	.....
54,000	.0068	.....
55,000	.0070	.0012	
56,000	.0072	.....
57,000	.0075	.....
58,000	.0079	.....
59,000	.0082	.....
60,000	.0086	.0023	
62,000	.0098	.....
64,000	.0103	.....
66,000	.0115	.....
68,000	.0131	.....
70,000	.0149	.0069	
72,000	.0165	.....
74,000	.0185	.....
76,000	.0220	.....
78,000	.0248	.....
80,000	.0280	.0183	
82,000	.0311	.....
84,000	.0369	.....
86,000	.0409	.....
88,000	.0471	.....
90,000	.0582	.0420	
92,000	.06	.....
96,000	.08	.....
100,000	.11	Tensile strength. -10.7 per cent.
103,600	.....	.....
0	.32	.....

Elongation of inch sections, ".03, ".23*, ".06.

Diameter at fracture, ".40; area, .1257 square inch.

Contraction of area, 49.7 per cent.

Appearance of fracture, fine silky.





PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-14, NO. 7786, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED LOW CHERRY AND DRAWN DOWN UNDER THE HAMMER
AT NEARLY THE SAME TEMPERATURE. QUENCHED IN WATER.

No. 7786.

Heated to a low cherry (expansion, ".069 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 36.6 per cent.

Quenched in water.

Marks, C6-14.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0029	.....
40,000	.0039	0.	
50,000	.0051	.0001	Elastic limit.
51,000	.0053	.....
52,000	.0056	.....
53,000	.0059	.....
54,000	.0062	.....
55,000	.0066	.0010	
56,000	.0070	.....
57,000	.0076	.....
58,000	.0085	.....
59,000	.0100	.....
60,000	.0188	.0120	
61,000	.0220	.....
62,000	.0220	.....
63,000	.0260	.....
64,000	.0425	.....
66,000	.0530	.....
68,000	.0640	.....
70,000	.0782	.0692	
72,000	.09	.....
76,000	.14	.....
80,000	.21	.....
82,720	.....	.....	Tensile strength.
0	.56	.....	=18.3 per cent.

Elongation of inch sections, ".15, ".13, ".27*.

Diameter at fracture, ".45; area, .1590 square inch.

Contraction of area, 36.4 per cent.

Appearance of fracture, silky.

No. 7787.

Heated to a blood red (expansion, ".058 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 29.9 per cent.

Quenched in water.

Marks, C6-15.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads, per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	-----	
20,000	.0019	-----	
30,000	.0029	-----	
40,000	.0039	0.	
50,000	.0050	0.	
56,000	.0066	-----	
57,000	.0068	-----	
58,000	.0060	-----		Elastic limit.
59,000	.0066	-----	
60,000	.0068	.0008	
61,000	.0071	-----	
62,000	.0074	-----	
63,000	.0079	-----	
64,000	.0088	-----	
65,000	.0096	.0029	
66,000	.0109	-----	
67,000	.0120	-----	
68,000	.0171	-----	
69,000	.0210	-----	
70,000	.0300	.0220	
72,000	.0890	-----	
74,000	.0570	-----	
76,000	.0668	-----	
78,000	.0810	-----	
80,000	.1070	.0968	
84,000	.17	-----	
85,600	-----	-----	Tensile strength. =6.7 per cent.
0	.20	-----	

Elongation of inch sections, ".10", ".05", ".05.

Diameter at fracture, ".53; area, .2206 square inch.

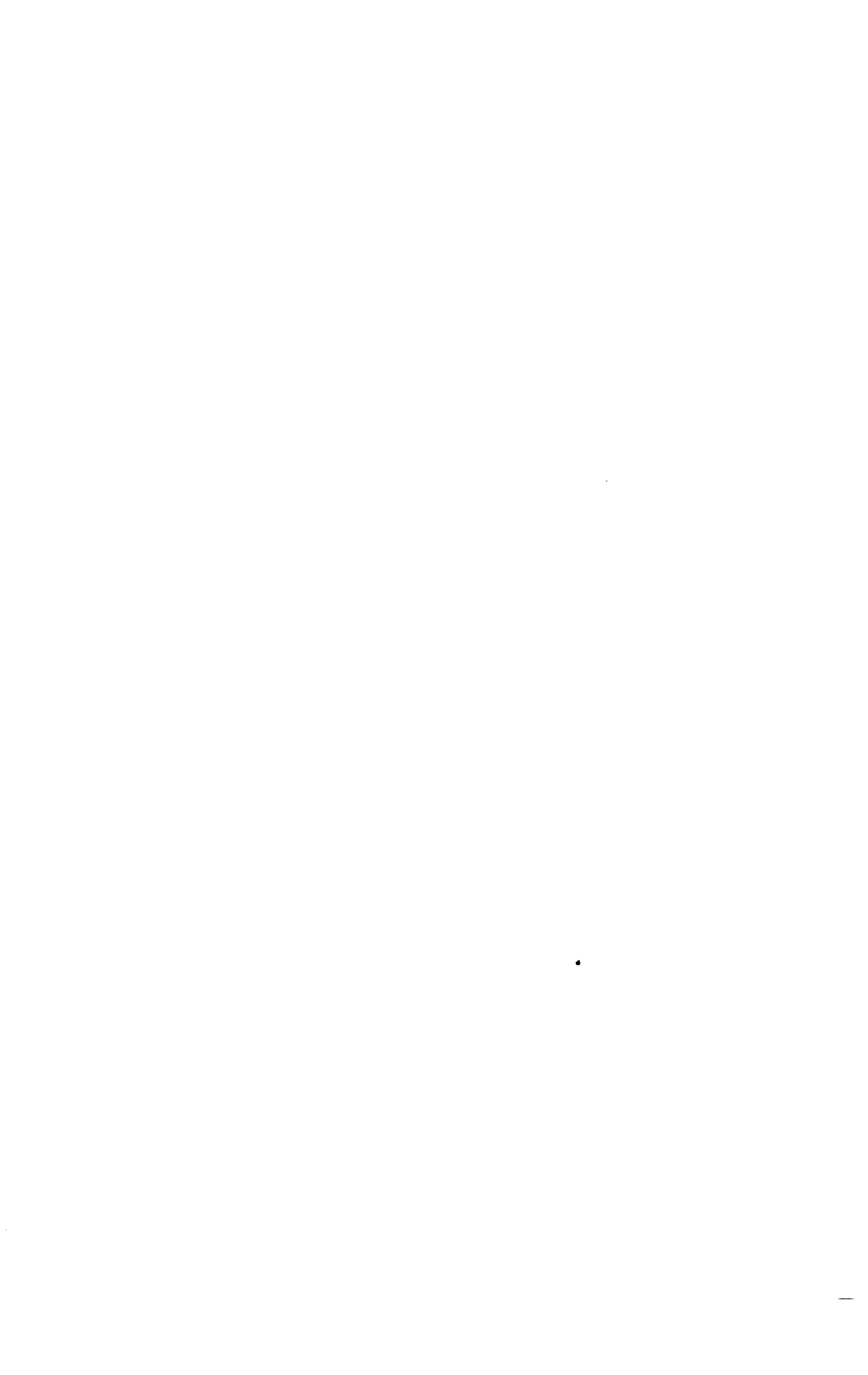
Contraction of area, 11.8 per cent.

Appearance of fracture, medium granular.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-15, NO. 7787, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BLOOD RED AND DRAWN DOWN UNDER THE HAMMER
AT NEARLY THE SAME TEMPERATURE. QUENCHED IN WATER.







PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C6-16, NO. 7788, CROSS SECTION.
16-INCH BY 18-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED NEARLY WHITE HOT AND DRAWN DOWN UNDER THE HAMMER
AT NEARLY THE SAME TEMPERATURE. QUENCHED IN WATER.

No. 7788.

Heated to nearly white heat (expansion, ".125 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 48.2 per cent.

Quenched in water.

Marks, C6-16.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0030	.....
40,000	.0041	.0001	Elastic limit, approximate.
41,000	.0044	.....
42,000	.0047	.....
43,000	.0049	.....
44,000	.0050	.....
45,000	.0051	.0006	
46,000	.0053	.....
47,000	.0057	.....
48,000	.0059	.....
49,000	.0061	.....
50,000	.0062	.0011	
51,000	.0065	.....
52,000	.0068	.....
53,000	.0070	.....
54,000	.0072	.....
55,000	.0074	.0018	
56,000	.0078	.....
58,000	.0084	.....
60,000	.0090	.0028	
62,000	.0096	.....
64,000	.0103	.....
66,000	.0111	.....
68,000	.0120	.....
70,000	.0135	.0059	
72,000	.0148	.....
74,000	.0159	.....
76,000	.0175	.....
78,000	.0198	.....
80,000	.0222	.0130	
84,000	.03	.....
88,000	.05	.....
92,000	.06	.....
96,000	.07	.....
100,000	.08	.....
104,000	.10	.....
108,000	.14	.....
110,880	.....	.....	Tensile strength.
0	.30	.....	=10 per cent.

Elongation of inch sections, ".06, ".21*, ".03.

Diameter at fracture, ".45; area, .1590 square inch.

Contraction of area, 36.4 per cent.

Appearance of fracture, silky.

No. 7789.

Heated to nearly white heat (expansion ".115 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 46.3 per cent.

Quenched in water.

Marks, C6-17.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010		
20,000	.0020		
30,000	.0030		
40,000	.0041	.0001	Elastic limit, approximate.
45,000	.0051	.0007	
50,000	.0062	.0011	
55,000	.0075	.0019	
60,000	.0092	.0030	
65,000	.0113	.0048	
70,000	.0150	.0071	
75,000	.0200	.0111	
80,000	.0270	.0185	
85,000	.0385	.0284	
90,000	.0536	.0423	
95,000	.07		
100,000	.10		
104,000			Tensile strength.
0	.34		=11.3 per cent.

Elongation of inch sections, ".03, ".05, ".26*.

Diameter at fracture, ".41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Appearance of fracture, fine silky.

No. 7790.

Heated to a low yellow (expansion, ".060 in 7".22), and drawn down under the hammer at full red. Reduction, 37.8 per cent.

Cooled in the air.

Annealed at blood red, cooling in sand.

Marks, C6-18.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0029	0.	
40,000	.0040	0.	
48,000	.0042	.....	Elastic limit.
44,000	.0050	.....	Load fell.
38,000	.0112	.....
40,000	.0718	.0687	
41,000	.0750	.....
42,000	.0809	.....
43,000	.0852	.....
44,000	.0920	.....
46,000	.10	.....
48,000	.12	.....
50,000	.14	.....
52,000	.16	.....
54,000	.20	.....
56,000	.25	.....
60,000	.31	.....
64,000	.64	.....	Tensile strength.
0	.78	.....	=26 per cent.

Elongation of inch sections, ".44*", ".17, ".17.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Appearance of fracture, silky.

No. 7791.

Heated to a low yellow (expansion, ".082 in 7".22), and drawn down under the hammer at full red. Reduction, 45.1 per cent.

Cooled in the air.

Annealed at cherry red, cooling in sand.

Marks, C6-19.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0021	.....
30,000	.0081	0.	
40,000	.0042	0.	
43,000	.0044	.....
44,000	.0048	.....
41,000	.0099	.....
42,000	.0155	.....
43,000	.0612	Elastic limit. Load fell.
44,000	.0880	.....
45,000	.0915	.....
46,000	.0970	.....
48,000	.10	.....
50,000	.12	.....
52,000	.15	.....
54,000	.17	.....
56,000	.19	.....
58,000	.24	.....
60,000	.29	Tensile stre =30.3 per cen..
62,000	.37	.....
64,000	.60	.....
64,400	.....	.....
0	.91	

Elongation of inch sections, ".22, ".48*, ".21.

Diameter at fracture, ".39; area, .1194 square inch.

Contraction of area, 52.2 per cent.

Appearance of fracture, silky.

No. 7792.

Heated to a yellow (expansion, ".089 in 7".22), and drawn down under the hammer at full red. Reduction, 43.9 per cent.

Cooled in the air.

Annealed at bright red, cooling in sand.

Marks, C6-20.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0081	0.	Elastic limit. Load fell.
40,000	.0041	0.	
40,500	.0042	.....
36,000	.0150 .0180	.....
37,000		.0210	
38,000	.0580	.....
39,000	.0610	.....
40,000	.0670	.0617	
41,000	.0695	.....
42,000	.0769	.....
43,000	.0610	.....
44,000	.0890	.....
46,000	.10	.....
48,000	.11	.....
50,000	.18	.....
52,000	.15	.....
54,000	.18	.....
56,000	.21	.....
58,000	.25	.....
60,000	.32	.....
62,000	.44	.....
63,200	Tensile strength. =27.3 per cent.
0	.82	.....

Elongation of inch sections, ".49*", ".19", ".14.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Appearance of fracture, silky.

No. 7793.

Heated to a yellow (expansion, ".082 in 7".22), and drawn down under the hammer at full red. Reduction, 43.9 per cent.

Cooled in the air.

Annealed at low yellow, cooling in sand.

Marks, C6-21.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0011	Elastic limit. Load fell.
20,000	.0021	.....
30,000	.0032	0.	
35,000	.0038	.....
36,000	.0041	.....
37,000	.0041	.....
38,000	.0042	.....
39,000	.0122	.....
40,000	.0420	.....
41,000	.0470	.....
42,000	.0508	.....
44,000	.0585	.....
46,000	.0598	.....
48,000	.0620	.....
50,000	.0670	.....
52,000	.0780	.....
54,000	.0800	.....
56,000	.09	.....
58,000	.10	.....
60,000	.12	.....
62,000	.14	.....
64,000	.16	.....
66,000	.19	.....
68,000	.22	.....
70,000	.26	.....
72,000	.34	.....
74,000	.47	.....
76,000	Tensile strength. =29.3 per cent.
0	.88	.....

Elongation of inch sections, ".15, ".34*, ".39*.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Appearance of fracture, silky.

No. 7794.

Heated to a yellow (expansion, ".103 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 48.2 per cent.

Cooled in the air.

Annealed at bright yellow, cooling in sand.

Marks, C6-22.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0030	0.	
33,000	.0032	.....	Elastic limit. Load fell.
33,500	.0033	.....
32,000	.0079	.....
33,000	.0200	.....
31,000	.0222	.....
32,000	.0367	.....
33,000	.0393	.....
34,000	.0415	.....
35,000	.0440	.....
36,000	.0490	.....
37,000	.0523	.....
38,000	.0589	.....
40,000	.0689	.....
42,000	.0788	.....
44,000	.09	.....
46,000	.10	.....
48,000	.11	.....
50,000	.13	.....
52,000	.15	.....
54,000	.18	.....
56,000	.22	.....
58,000	.27	.....
60,000	.34	.....
62,000	.53	.....	Tensile strength.
0	.90	.....	= 30 per cent.

Elongation of sections, ".17, ".50*, ".23.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Appearance of fracture, silky.

No. 7795.

Heated to a yellow (expansion, ".090 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 51.8 per cent.

Cooled in the air.

Annealed at white heat, cooling in sand.

Marks, C6-23.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0031	.0001	
31,000	.0033	.....	Elastic limit. Load fell.
31,800	.0035	.....
28,000	.0035	.....
30,000	.0140	.....
	.0330	.....
31,000	.0347	.....
32,000	.0380	.....
33,000	.0417	.....
34,000	.0460	.....
35,000	.0500	.....
36,000	.0555	.....
38,000	.0656	.....
40,000	.0765	.....
42,000	.0884	.....
44,000	.1005	.....
46,000	.11	.....
48,000	.12	.....
50,000	.15	.....
52,000	.17	.....
54,000	.20	.....
56,000	.25	.....
58,000	.30	.....
60,000	.43	.....
61,520	.....	.....	Tensile strength.
0	.88	.....	=29.3 per cent.

Elongation of inch sections, ".48*", ".22", ".18.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Appearance of fracture, silky.

No. 7796.

Heated to a yellow (expansion, ".083 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 51.2 per cent.

Cooled in the air.

Annealed at scintillating heat, cooling in sand.

Marks, C6-24.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
28,000	.0024	.....	Elastic limit.
24,000	.0026	.....
25,000	.0026	.0009	
26,000	.0065	.....
27,000	.0060	.....
28,000	.0111	.....
29,000	.0120	.....
30,000	.0161	.0129	
31,000	.0188	.....
32,000	.0810	.....
33,000	.0830	.....
34,000	.0870	.....
35,000	.0400	.....
36,000	.0450	.....
38,000	.0550	.....
40,000	.0835	.....
42,000	.0740	.....
44,000	.0860	.....
46,000	.0990	.....
48,000	.1140	.....
50,000	.18	.....
52,000	.15	.....
54,000	.17	.....
56,000	.20	.....
58,000	.25	.....
60,000	.31	.....
62,000	.40	.....
62,720	.....	.....	Tensile strength.
0	.72	.....	=24 per cent.

Elongation of inch sections, ".39*", ".15", ".18.

Diameter at fracture, ".41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Appearance of fracture, silky.

No. 7797.

Heated to a yellow (expansion, ".097 in 7".22), and drawn down under the hammer at nearly the same temperature. Reduction, 48.2 per cent.

Cooled in the air.

Reheated to a bright red and quenched in water.

Marks, C6-25.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	-----	
20,000	.0019	-----	
30,000	.0029	0.	
40,000	.0089	0.	
50,000	.0050	0.	
55,000	.0058	.0002	
56,000	.0060	-----	Elastic limit. Load fell.
57,000	.0061	-----	
58,000	.0097	-----	
57,000	.0123	-----	
58,000	.0178	-----	
59,000	.0210	-----	
60,000	.0488	.0360	
62,000	.0470	-----	
64,000	.0550	-----	
66,000	.0646	-----	
68,000	.0740	-----	
70,000	.0842	-----	
72,000	.0958	-----	
74,000	.10	-----	
76,000	.11	-----	
78,000	.13	-----	
80,000	.16	-----	
82,000	.19	-----	
84,000	.24	-----	
86,520	-----	-----	Tensile strength.
0	.57	-----	=19 per cent.

Elongation of inch sections, ".09, ".11, ".37*.

Diameter at fracture, ".38; area, .1134 square inch.

Contraction of area, 54.6 per cent.

Appearance of fracture, silky.

TABLATION OF TENSION SPECIMENS FROM 16" BY 18" CARBON STEEL INGOT.
 FORGED SPECIMENS—SQUARE BARS DRAWN DOWN TO ROUNDS AT DIFFERENT TEMPERATURES.
 STEMS OF SPECIMENS, .564 DIAM., 8" LONG.

No. of test.	Treatment.	Reduction.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of inch sections.	Elongation of inch sections.	Appearance of fracture.
7776	Heated low yellow and drawn down under the hammer, finishing at black heat. Cooled in air.	46.3	Pounds. 80,000	Pounds. 90,480	Per cent. 7.7	Per cent. 24.6	" "	Silky, irregular surface.
7774	Heated full yellow and drawn down under the hammer at bright red. Cooled in air.	32.3	46,000	64,980	31.0	57.0	.06, .04, .16 ^a	Silky.
7776	Heated bright yellow and drawn down under the hammer at full yellow. Cooled in air.	38.5	40,800	65,620	24.0	38.2	.21, .50 ^a , .21	Silky; spot of lighter-colored metal .06 diameter.
7776	Heated low white and drawn down under the hammer at bright lemon. Cooled in air.	32.3	36,000	64,800	22.7	49.7	.42 ^a , .16, .11	Silky.
7777	Heated full cherry and drawn down under the hammer at nearly same. Cooled in air.	20.1	48,800	64,000	17.8	27.6	.21 ^a , .20, .11	Silky, oblique.
7778	Heated low cherry and drawn down under the hammer at nearly same. Cooled in air.	23.8	49,000	66,400	25.0	44.6	.20, .38 ^a , .17	Silky.
7779	Heated blood red and drawn down under the hammer at nearly same. Cooled in air.	16.5	α 84,000	61,200	10.7	24.6	.20 ^a , .06, .04	Gray, amorphous, oblique.
7780	Heated blood red and drawn down under the hammer at nearly same. Cooled in air.	48.9	39,000	65,200	18.0	48.7	.37 ^a , .11, .06	Silky.
7781	Heated blood red and drawn down under the hammer at nearly same. Cooled in air.	31.1	50,000	74,880	9.0	21.4	.07, .16 ^a , .04	Dull silky.
7782	Heated bright red and drawn down under the hammer at full red. Quenched in water.	48.9	60,000	96,480	16.0	30.6	.11, .27 ^a , .10	Dull silky, irregular, oblique.
7783	Heated yellow and drawn down under the hammer at nearly same. Quenched in water.	42.1	53,000	96,480	17.0	49.7	.08, .32 ^a , .11	Silky.
7784	Heated bright yellow and drawn down under the hammer at nearly same. Quenched in water.	48.3	α 48,000	108,600	10.7	49.7	.08, .23 ^a , .06	Fine silky.
7785	Heated high red and drawn down under the hammer at nearly same. Quenched in water.	33.5	59,000	91,600	12.3	30.6	.06, .06, .23 ^a	Silky with spot of light-colored metal.
7786	Heated low cherry and drawn down under the hammer at nearly same. Quenched in water.	36.6	51,000	82,720	18.3	38.4	.15, .13, .27 ^a	Silky.
7787	Heated blood red and drawn down under the hammer at nearly same. Quenched in water.	29.9	58,000	85,600	6.7	11.8	.10 ^a , .06, .06	Medium granular.
7788	Heated nearly white hot and drawn down under the hammer at nearly same. Quenched in water.	46.2	α 40,000	110,880	10.0	38.4	.06, .21 ^a , .08	Silky.
7789	Heated nearly white hot and drawn down under the hammer at nearly same. Quenched in water.	46.3	α 40,000	104,000	11.3	47.2	.08, .06, .29 ^a	Fine silky.

^a Approximate.

FORGED SPECIMENS—SQUARE BARS DRAWN DOWN TO ROUNDS AT DIFFERENT TEMPERATURES—Continued.

STEMS OF SPECIMENS, ".564 DIAM., .3" LONG—Continued.

No. of test.	Treatment.	Reduction.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
7790	Heated low yellow and drawn down under the hammer at full red. Cooled in air. Annealed at blood red, cooling in sand.	37.8	43,000	64,000	26.0	57.0	.44*, .17, .17	Silky.
7791	Heated low yellow and drawn down under the hammer at full red. Cooled in air. Annealed at cherry red, cooling in sand.	45.1	48,000	64,400	30.3	52.2	.22, .48*, .21	Do.
7792	Heated yellow and drawn down under the hammer at full red. Cooled in air. Annealed at bright red, cooling in sand.	43.9	40,500	63,200	27.3	57.0	.49*, .19, .14	Do.
7793	Heated yellow and drawn down under the hammer at full red. Cooled in air. Annealed at low yellow, cooling in sand.	43.9	35,000	62,800	29.3	57.0	.15, .34, .33*	Do.
7794	Heated yellow and drawn down under the hammer at nearly same. Cooled in air. Annealed at bright yellow, cooling in sand.	43.2	33,500	62,000	30.0	57.0	.17, .50*, .23	Do.
7795	Heated yellow and drawn down under the hammer at nearly same. Cooled in air. Annealed at white heat, cooling in sand.	51.8	31,800	61,520	29.3	57.0	.48*, .22, .18	Do.
7796	Heated yellow and drawn down under the hammer at nearly same. Cooled in air. Annealed at scintillating heat, cooling in sand.	51.2	23,000	62,720	24.0	47.2	.38*, .15, .18	Do.
7797	Heated yellow and drawn down under the hammer at nearly same. Cooled in air. Reheated to bright red and quenched in water.	43.2	57,000	86,560	19.0	54.6	.09, .11, .37*	Do.

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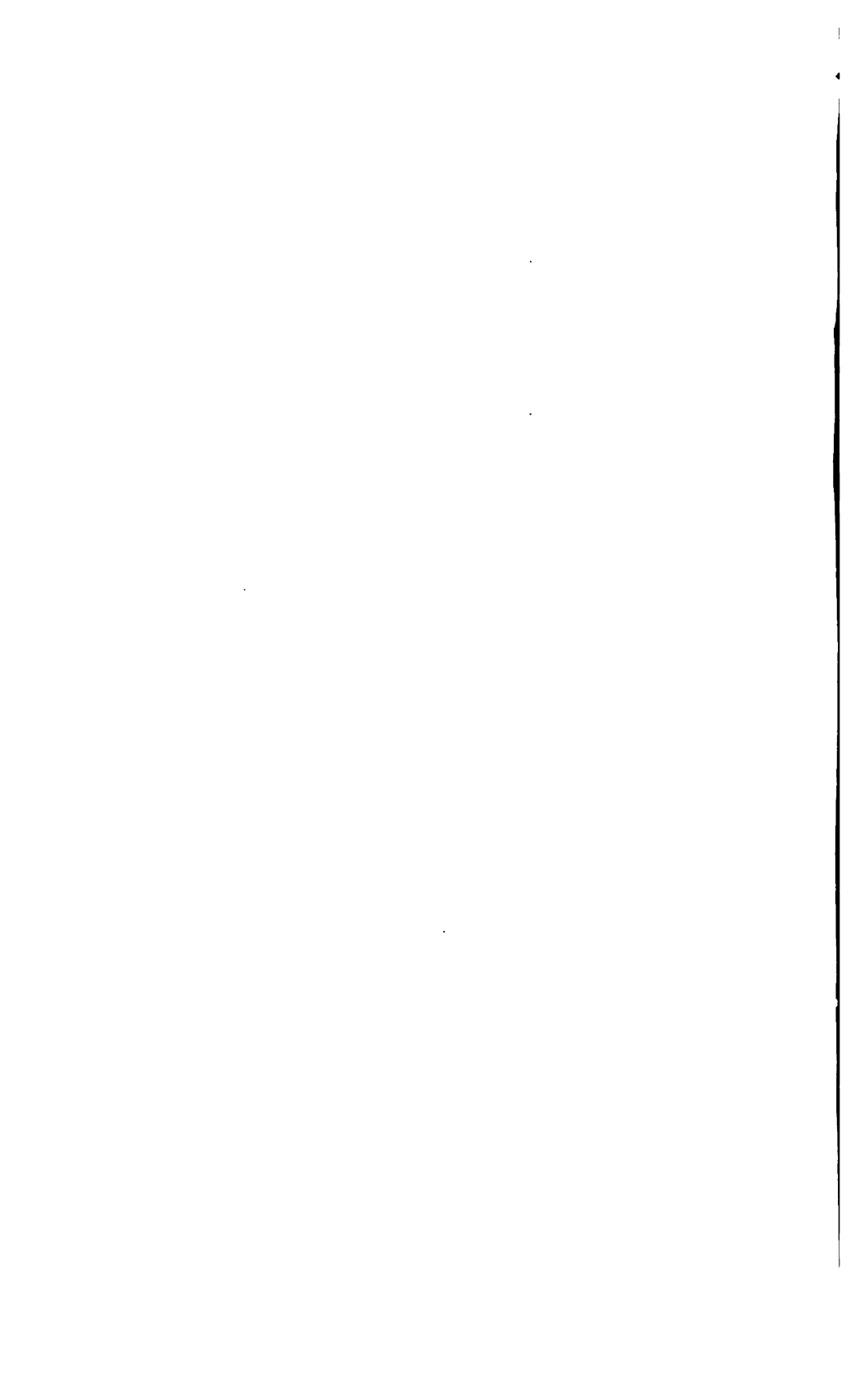
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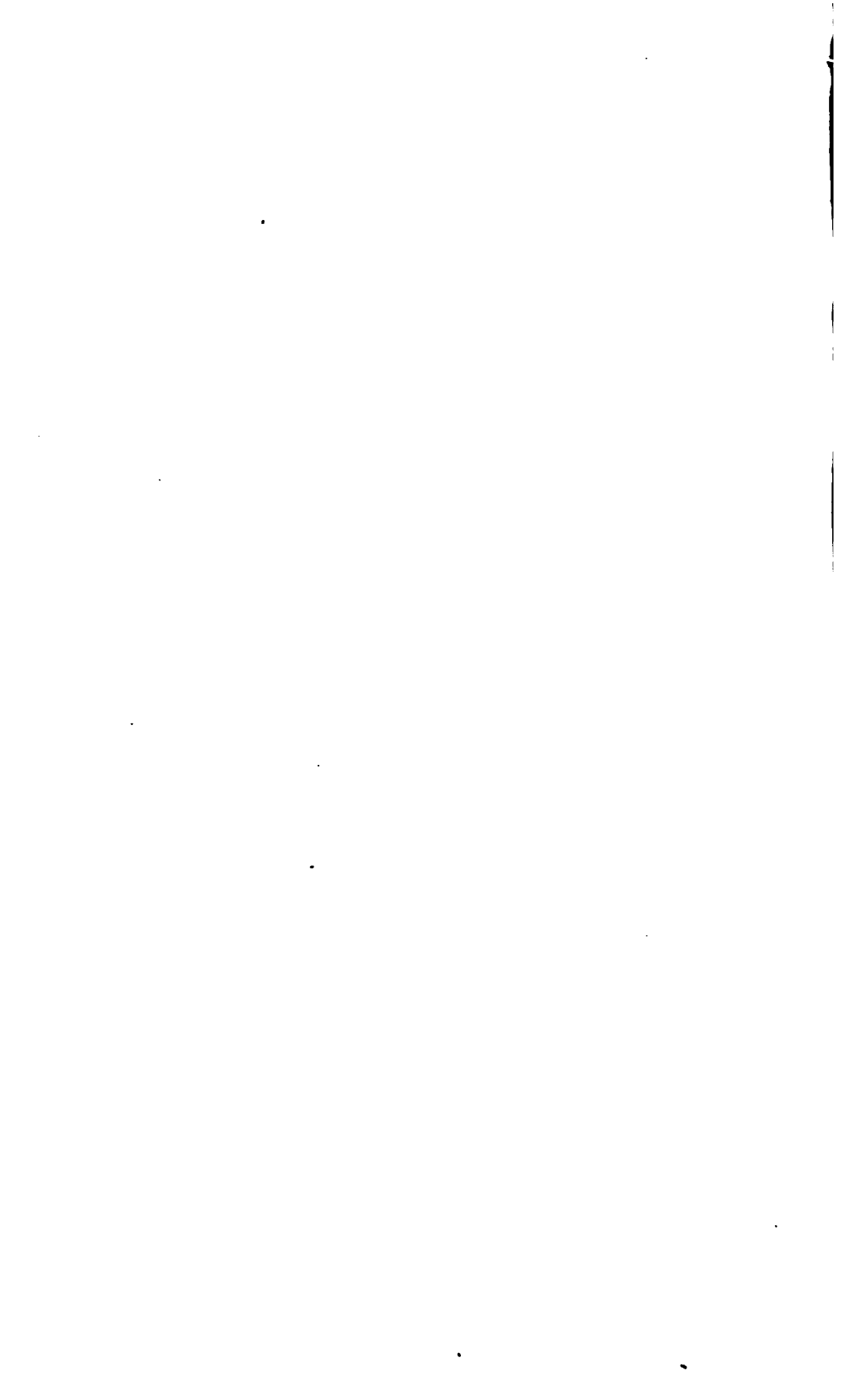
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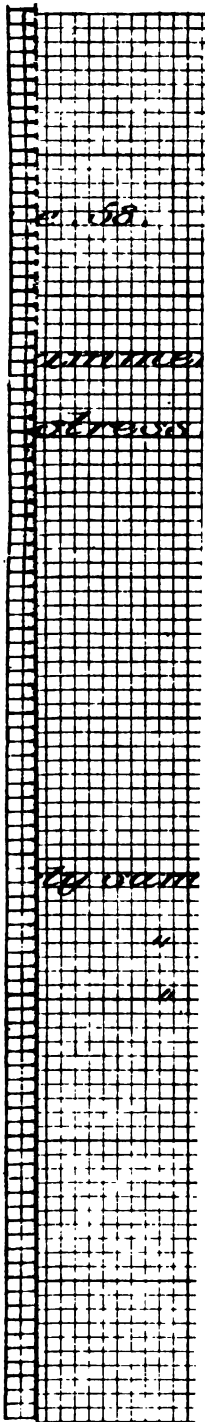
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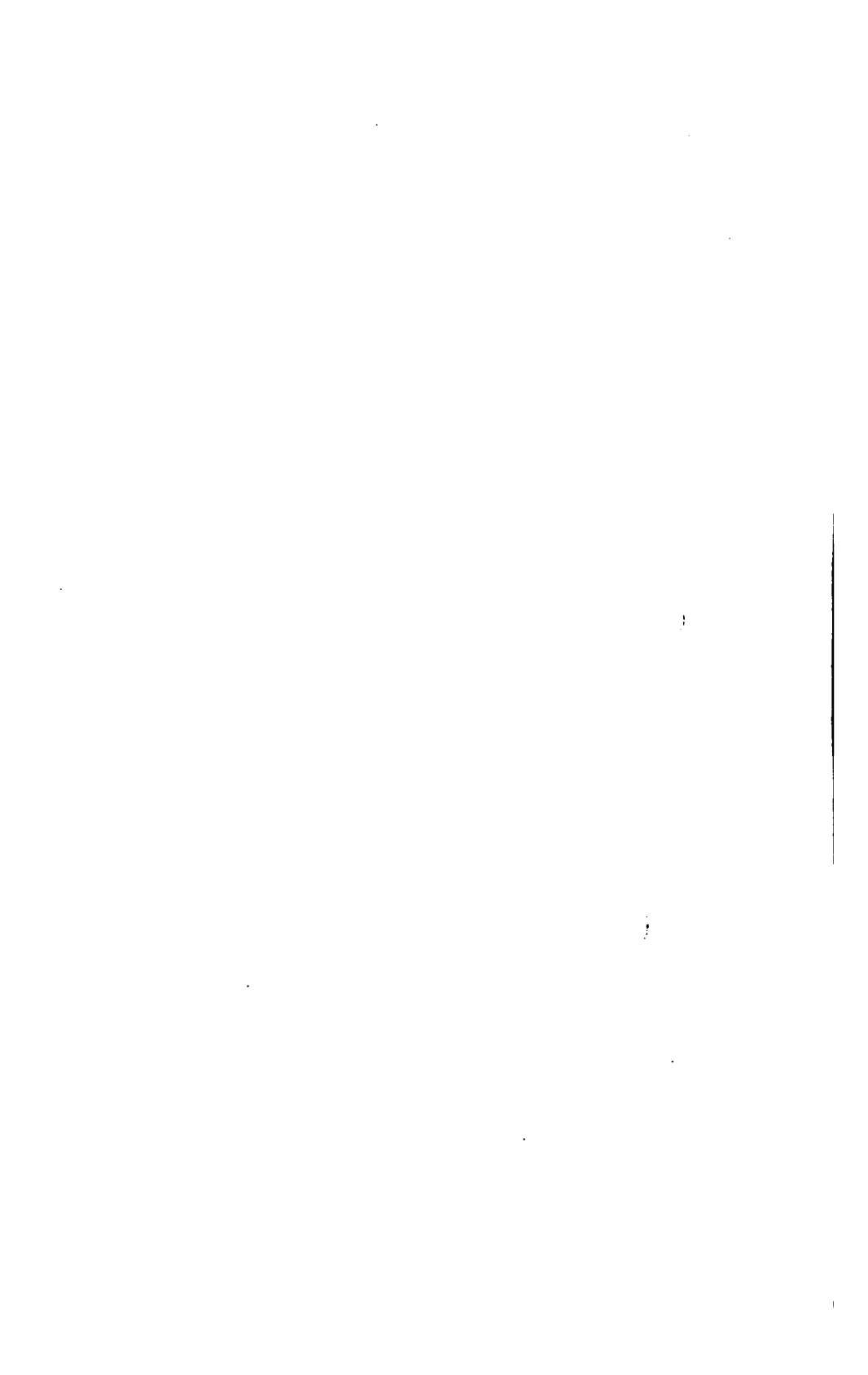
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METAL FROM 16" BY 18" CARBON STEEL INGOT.

FORGED SPECIMENS, SQUARE BARS DRAWN DOWN TO SQUARE BARS AT DIFFERENT TEMPERATURES.

Original dimensions of specimens, 1".5 x 1".5 x 7".25 long.

No. 7876.

Heated white hot (expansion, ".125 in 7".25), and drawn down under the hammer at same temperature. Reduction, 52 per cent.

Cooled in open air.

Marks, 1.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0008	.....
20,000	.0018	.....
30,000	.0028	.....
40,000	.0039	0.	
41,000	.0040	.....
42,000	.0042	.....
43,000	.0044	.....	Elastic limit. Load fell.
35,000	.0037	.....
36,000	.0038	.....
37,000	.0110	.....
38,000	.0220	.....
39,000	.0460	.....
40,000	.0480	.0482	
41,000	.0500	.....
42,000	.0542	.....
44,000	.0648	.....
46,000	.0760	.....
48,000	.0896	.....
50,000	.1026	.0958	
52,000	.12	.....
54,000	.14	.....
56,000	.16	.....
58,000	.19	.....
60,000	.21	.....
62,000	.26	.....
64,000	.35	.....
66,000	.45	.....
66,480	.55	.....	Tensile strength.
	.71	.....
0	1.08	.....	--34.3 per cent.

Load on bar at time of rupture, 13,000 pounds=135,140 pounds per square inch on area at fracture.

Elongation of inch sections, ".27, ".52*, ".24.

Diameter at fracture, ".35; area, .0962 square inch.

Contraction of area, 61.5 per cent.

Fractured 1".6 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7877.

Heated white hot (expansion, ".126 in 7".25), and drawn down under the hammer at same temperature. Reduction, 52.9 per cent.

Cooled in sand.

Marks, 2.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0008	.....
20,000	.0019	.....
30,000	.0030	.....
38,000	.0039	.....	Elastic limit. Load fell.
32,000	.0120	.....
33,000	.0128	.....
34,000	.0165	.....
35,000	.0201	.....
36,000	.0480	.....
38,000	.0555	.....
40,000	.0650	.0601	
42,000	.0748	.....
44,000	.0872	.....
46,000	.1008	.....
48,000	.1185	.....
50,000	.1402	.1382	
52,000	.17	.....
54,000	.20	.....
56,000	.28	.....
58,000	.26	.....
60,000	.38	.....
62,000	.49	.....
62,480	.68	.....	Tensile strength.
0	.92	.....	=30.7 per cent.

Load on bar at time of rupture, 12,500 pounds=129,940 pounds per square inch on area at fracture.

Elongation of inch sections, ".45", ".25", ".22.

Diameter at fracture, ".35; area, .0962 square inch.

Contraction of area, 61.5 per cent.

Fractured 1".05 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7878.

Heated white hot (expansion, ".122 in 7".25), and drawn down under the hammer at same temperature. Reduction, 49.8 per cent.

Quenched in oil.

Marks, 3.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0018	.....
30,000	.0028	.....
35,000	.0038	.....
40,000	.0038	0.	
45,000	.0044	.....
50,000	.0050	0.	
51,000	.0052	.....	Elastic limit.
52,000	.0055	.....
58,000	.0059	.....
54,000	.0198	.....
55,000	.0213	.0149	
56,000	.0239	.....
57,000	.0267	.....
58,000	.0302	.....
59,000	.0329	.....
60,000	.0375	.0300	
62,000	.0452	.....
64,000	.0539	.....
66,000	.0614	.....
68,000	.0720	.....
70,000	.0807	.0714	
72,000	.09	.....
74,000	.10	.....
76,000	.11	.....
78,000	.13	.....
80,000	.17	.....
82,000	.21	.....
84,000	.27	.....
85,200	.36	.....	Tensile strength.
0	.60	.....	=20 per cent.

Load on bar at time of rupture, 15,600 pounds=171,810 pounds per square inch on area at fracture.

Elongation of inch sections, ".10, ".20, ".30 *.

Diameter at fracture, ".34; area, .0908 square inch.

Contraction of area, 63.7 per cent.

Fractured 1".15 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7879.

Heated to a bright yellow (expansion, ".110 in 7".25), and drawn down under the hammer at same temperature. Reduction, 50.7 per cent.

Cooled in open air.

Marks, 4.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0008	.....
20,000	.0018	.....
30,000	.0029	0.	
35,000	.0084	Elastic limit. Load fell.
40,000	.0089	0.	
21,000	.0041	.....
36,000	.0049	.....
37,000	.0080	.....
38,000	.0485	.....
39,000	.0455	.....
40,000	.0491	.0442	
42,000	.0574	.....
44,000	.0670	.....
46,000	.0780	.....
48,000	.0900	.....
50,000	.1089	.0971	
52,000	.12	.....
54,000	.14	.....
56,000	.16	.....
58,000	.19	.....
60,000	.22	.....
62,000	.27	.....
64,000	.33	.....
66,000	.47	.....
66,080	Tensile strength.
0	.84	=28 per cent.

Load on bar at time of rupture, 13,100 pounds=128,680 pounds per square inch on area at fracture.

Elongation of inch sections, ".19, ".40*, ".25.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 59.3 per cent.

Fracture at the middle of the stem.

Appearance of fracture, fine silky, cup-shaped.

No. 7880.

Heated to a bright yellow (expansion, ".108 in 7".25), and drawn down under the hammer at same temperature. Reduction, 50.2 per cent.

Cooled in sand.

Marks, 5.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0080	.....
35,000	.0086	0.	
39,000	.0040	.....
40,000	.....	.....	Elastic limit. Load fell.
34,000	.0080	.....
35,000	.0111	.....
36,000	.0251	.....
37,000	.0806	.....
38,000	.0889	.....
39,000	.0627	.....
40,000	.0571	.0621	
42,000	.0650	.....
44,000	.0766	.....
46,000	.0864	.....
48,000	.1018	.....
50,000	.1143	.1076	
52,000	.13	.....
54,000	.15	.....
56,000	.18	.....
58,000	.21	.....
60,000	.25	.....
62,000	.30	.....
64,000	.40	.....
64,800	.54	.....	Tensile strength.
0	.81	.....	=27 per cent.

Load on bar at time of rupture, 13,000 pounds=127,700 pounds per square inch on area at fracture.

Elongation of inch sections, ".16, ".43*, ".22.

Diameter at fracture ".36; area, .1018 square inch.

Contraction of area, 59.3 per cent.

Fractured 1".4 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7881.

Heated to a bright yellow (expansion, ".113 in 7".25), and drawn down under the hammer at same temperature. Reduction, 48.9 per cent.

Quenched in oil.

Marks, 6.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0030	.....
35,000	.0035	.....
40,000	.0040	0.	
45,000	.0045	0.	
50,000	.0050	.0001	Elastic limit.
52,000	.0055	.....	Load fell.
53,000	.0070	.....
51,000	.0075	.....
52,000	.0170	.....
53,000	.0265	.....
54,000	.0297	.....
55,000	.0382	.....
55,000	.0450	.....
60,000	.0538	.0460	
62,000	.0600	.....
64,000	.0710	.....
65,000	.0805	.....
68,000	.0855	.....
70,000	.1110	.1014	
72,000	.12	.....
74,000	.14	.....
76,000	.17	.....
78,000	.21	.....
80,000	.26	.....
81,280	.45	.....	Tensile strength.
0	.77	.....	=25.7 per cent.

Load on bar at time of rupture, 14,800 pounds=163,000 pounds per square inch on area at fracture.

Elongation of inch sections, ".32", ".28", ".17.

Diameter at fracture, ".34; area, .0908 square inch.

Contraction of area, 63.7 per cent.

Fractured 1".27 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7882.

Heated to a low yellow (expansion, ".093 in 7".25), and drawn down under the hammer at same temperature. Reduction, 51.6 per cent.

Cooled in the open air.

Marks, 7.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	0.		
35,000	.0035	.....	
40,000	.0040	0.		
44,000	.0045	.....	
44,600		Elastic limit. Load fell.
40,000	.0067	.....	
41,000	.0129	.....	
40,000	.0810	.....	
41,000	.0672	.....	
42,000	.0594	.....	
43,000	.0611	.....	
44,000	.0655	.....	
46,000	.0758	.....	
48,000	.0879	.....	
50,000	.1021	.0955		
52,000	.12	.....	
54,000	.14	.....	
56,000	.16	.....	
58,000	.18	.....	
60,000	.21	.....	
62,000	.25	.....	
64,000	.31	.....	
66,000	.42	.....	
67,200	.62	Tensile strength. =27 per cent.	
0	.81	.....	

Load on bar at time of rupture, 13,900 pounds=129,300 pounds per square inch on area at fracture.

Elongation of inch sections, ".46*", ".19", ".16.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Fractured ".6 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7883.

Heated to a low yellow (expansion, ".100 in 7".25), and drawn down under the hammer at same temperature. Reduction, 52 per cent.

Cooled in sand.

Marks, 8.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0029	0.	
35,000	.0084	.....
38,000	.0038	.....	Elastic limit. Load fell.
34,000	.0100	.....
35,000	.0115	.....
36,000	.0255	.....
37,000	.0405	.....
39,000	.0600	.....
40,000	.0648	.0600	
41,000	.0692	.....
42,000	.0760	.....
43,000	.0823	.....
44,000	.0898	.....
46,000	.1042	.....
48,000	.1193	.....
50,000	.1390	.1326	
52,000	.16	.....
54,000	.18	.....
56,000	.22	.....
58,000	.27	.....
60,000	.35	.....
62,000	.44	.....
68,040	.74	.....	Tensile strength.
0	.98	.....	=32.7 per cent.

Load on bar at time of rupture, 12,900 pounds=120,000 pounds per square inch on area at fracture.

Elongation of inch sections, ".50*", ".27, ".21.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Fractured 1".18 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7884.

Heated to a low yellow (expansion, ".100 in 7".25), and drawn down under the hammer at same temperature. Reduction, 48.4 per cent.

Quenched in oil.

Marks, 9.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0008	.....
20,000	.0019	.....
30,000	.0029	0.	
35,000	.0084	.....
40,000	.0089	0.	
45,000	.0044	.....
50,000	.0049	.0001	
52,000	.0062	.....
58,000	Elastic limit. Load fell.
48,000	.0088	.....
49,000	.0088	.....
50,000	.0180	.0079	
51,000	.0154	.....
52,000	.0324	.....
54,000	.0378	.....
56,000	.0456	.....
58,000	.0545	.....
60,000	.0627	.0662	
62,000	.0704	.....
64,000	.0680	.....
66,000	.0945	.....
68,000	.1096	.....
70,000	.1275	.1179	
72,000	.15	.....
74,000	.17	.....
76,000	.21	.....
78,000	.27	.....
78,880	.35	Tensile strength. =21.3 per cent.
0	.64	.....

Load on bar at time of rupture, 14,800 pounds=153,850 pounds per square inch on area at fracture.

Elongation of inch sections, ".10, ".41*, ".13.

Diameter at fracture, ".35; area, .0962 square inch.

Contraction of area, 61.5 per cent.

Fractured 1".48 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7885.

Heated to a cherry (expansion, ".079 in 7".25), and drawn down under the hammer at same temperature. Reduction, 48.4 per cent.

Cooled in the open air.

Marks, 10.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	.....
35,000	.0035	.....
40,000	.0041	0.	
44,000	.0044	.....	Elastic limit. Load fell.
40,000	.0112	.....
41,000	.0440	.....
42,000	.0600	.....
43,000	.0620	.....
44,000	.0659	.....
46,000	.0765	.....
48,000	.0875	.....
50,000	.1005	.0940	
52,000	.12	.....
54,000	.14	.....
56,000	.16	.....
58,000	.19	.....
60,000	.22	.....
62,000	.26	.....
64,000	.32	.....
66,000	.44	.....
66,560	.58	.....	ensile strength.
0	.80	.....	=26.7 per cent.

Elongation of inch sections, ".19, ".48*, ".13.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 59.3 per cent.

Fractured at the middle of the stem.

Appearance of fracture, fine silky, cup-shaped.

No. 7886.

Heated to a cherry (expansion, ".092 in 7".25), and drawn down under the hammer at same temperature. Reduction, 52 per cent.

Cooled in sand.

Marks, 11.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0019	.....
30,000	.0029	.....
35,000	.0034	.....
40,000	.0039	0.	Elastic limit.
41,000	.0040	.....	Load fall.
37,000	.0159	.....
38,000	.0290	.....
39,000	.0498	.....
40,000	.0585	.0486	
41,000	.0560	.....
42,000	.0600	.....
44,000	.0702	.....
46,000	.0680	.....
48,000	.0947	.....
50,000	.1128	.1061	
52,000	.13	.....
54,000	.15	.....
56,000	.17	.....
58,000	.20	.....
60,000	.24	.....
62,000	.28	.....
64,000	.37	.....
65,120	.48	.....	Tensile strength.
0	.85	.....	=28.3 per cent.

Load on bar at time of rupture, 13,100 pounds=121,860 pounds per square inch on area at fracture.

Elongation of inch sections, ".17, ".34*, ".34*.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Fractured 1".34 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7887.

Heated to a cherry (expansion, ".079 in 7".25), and drawn down under the hammer at same temperature. Reduction, 50.2 per cent.

Quenched in oil.

Marks, 12.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0080	.....
35,000	.0084	.....
40,000	.0089	0.	
45,000	.0044	.....
50,000	.0049	0.	
52,000	.0051	.....
54,000	.0053	.....
55,000	.0054	0.	Elastic limit.
56,000	.0060	.....	Load fell.
51,000	.0089	.....
52,000	.0114	.....
53,000	.0144	.....
54,000	.0164	.....
52,000	.0326	.....
53,000	.0359	.....
54,000	.0420	.....
55,000	.0436	.....
56,000	.0475	.....
58,000	.0560	.....
60,000	.0652	.0674	
62,000	.0744	.....
64,000	.0879	.....
66,000	.1003	.....
68,000	.1151	.....
70,000	.1351	.1253	
72,000	.16	.....
74,000	.18	.....
76,000	.23	.....
78,000	.30	.....
78,800	.45	.....	Tensile strength.
0	.73	.....	=24.3 per cent.

Load on bar at time of rupture, 14,800 pounds=163,000 pounds per square inch on area at fracture.

Elongation of inch sections, ".12, ".16, ".45*.

Diameter at fracture, ".34; area, .0908 square inch.

Contraction of area, 63.7 per cent.

Fractured 1".05 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7888.

Heated to a blood red (expansion, ".066 in 7".25), and drawn down under the hammer at the same temperature. Reduction, 49.8 per cent.

Cooled in the open air.

Marks, 13.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	0.	
35,000	.0034	.....
40,000	.0040	.0001	
45,000	.0048	.0008	
46,000	.0052	.....
47,000	.0054	.....
48,000	Elastic limit. Load fell.
48,000	.0099	.....
44,000	.0140	.....
45,000	.0730	.....
46,000	.0760	.....
47,000	.0809	.....
48,000	.0897	.....
49,000	.0956	.....
50,000	.1049	.0984	
52,000	.12	.....
54,000	.14	.....
56,000	.16	.....
58,000	.19	.....
60,000	.23	.....
62,000	.29	.....
64,000	.39	.....
64,600	.50	Tensile strength.
0	.71	= 23.7 per cent.

Elongation of inch sections, ".34*", ".23", ".14.

Diameter at fracture, ".43; area, .1452 square inch.

Contraction of area, 41.9 per cent.

Fractured ".85 from the neck.

Appearance of fracture, silky, oblique.

No. 7889.

Heated to a blood red (expansion, ".060 in 7".25), and drawn down under the hammer at same temperature. Reduction, 52 per cent.

Cooled in sand.

Marks, 14.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0029	0.	
35,000	.0034	.....
40,000	.0039	0.	
45,000	.0044	.....
50,000	.0050	0.	
51,000	.0051	.....	Elastic limit. Load fell.
43,000	.0138	.....
44,000	.0171	.....
45,000	.0737	.....
46,000	.0764	.....
47,000	.0799	.....
48,000	.0852	.....
49,000	.0900	.....
50,000	.0983	.0917	Present diameter of stem, ".555.
52,000	.11	.....
54,000	.12	.....
56,000	.15	.....
58,000	.17	.....
60,000	.20	.....
62,000	.23	.....
64,000	.30	.....
65,000	.40	.....
66,960	.60	.....	Tensile strength. =29.7 per cent.
0	.89	.....

Load on bar at time of rupture, 13,100 pounds=128,680 pounds per square inch on area at fracture.

Elongation of inch sections, ".15, ".25, ".49*.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 59.3 per cent.

Fractured 1" from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7890.

Heated to a blood red (expansion, ".065 in 7".25), and drawn down under the hammer at same temperature. Reduction, 51.6 per cent.

Quenched in oil.

Marks, 15.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	.....
20,000	.0018	.....
30,000	.0028	.....
35,000	.0033	.....
40,000	.0038	0.	
45,000	.0043	.....
50,000	.0048	0.	
55,000	.0055	.....	Elastic limit.
56,000	.0060	.....	Load fell.
56,800	.....	.....
52,000	.0109	.....
53,000	.0159	.....
54,000	.0221	.....
55,000	.0320	.....
56,000	.0452	.....
57,000	.0475	.....
58,000	.0526	.....
59,000	.0560	.....
60,000	.0612	.0537	Present diameter of stem, ".556.
62,000	.0709	.....
64,000	.0834	.....
66,000	.0938	.....
68,000	.1100	.....
70,000	.1246	.1150	Present diameter of stem, ".552.
72,000	.15	.....
74,000	.17	.....
76,000	.20	.....
78,000	.27	.....
79,280	.37	.....	Tensile strength.
0	.70	.....	=23.3 per cent.

Load on bar at time of rupture, 15,200 pounds=158,000 pounds per square inch on area at fracture.

Elongation of inch sections, ".07, ".16, ".47*.

Diameter at fracture, ".35; area, .0962 square inch.

Contraction of area, 61.5 per cent.

Fractured ".85 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7891.

Heated white hot (expansion, ".117 in 7".25), cooled to cherry red (expansion now ".059 in 7".25), then drawn down under the hammer at latter temperature. Reduction, 52.4 per cent.

Cooled in the open air.

Marks, 16.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0008	.....
20,000	.0018	.....
30,000	.0028	0.	
35,000	.0033	.....
40,000	.0038	0.	
45,000	.0043	.....
47,000	.0045	.....
48,000	.....	.....		Elastic limit. Load fell.
40,000	.0152	.....
41,000	.0440	.....
42,000	.0530	.....
43,000	.0612	.....
44,000	.0659	.....
46,000	.0755	.....
48,000	.0866	.....
50,000	.1015	.0950	
52,000	.11+	.....
54,000	.13	Present diameter of stem, ".554.
56,000	.15	.....
58,000	.18	.....
60,000	.20	.....
62,000	.24	.....
64,000	.30	.....
66,000	.43	.....
66,500	.55	.....
0	.83	.....

Load on bar at time of rupture, 12,900 pounds = 134,100 pounds per square inch on area at fracture.

Elongation of inch sections, ".14, ".49*, ".20.

Diameter at fracture, ".35; area, .0962 square inch.

Contraction of area, 61.5 per cent.

Fractured at the middle of the stem.

Appearance of fracture, fine silky, cup-shaped.

No. 7892.

Heated white hot (expansion, ".120 in 7".25), cooled to cherry red (expansion now ".061 in 7".25), then drawn down under the hammer at latter temperature. Reduction, 53.8 per cent.

Cooled in sand.

Marks, 17.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0008	.....
20,000	.0019	.....
30,000	.0029	0.	
35,000	.0084	.....
40,000	.0088	-.0001	
45,000	.0043	.....
46,000	.0044	.....
46,500	.....	.....	Elastic limit. Load fell.
89,000	.0101	.....
40,000	.0140	.....
41,000	.0698	.....
42,000	.0740	.....
43,000	.0770	.....
44,000	.0835	.....
46,000	.0940	.....
48,000	.1116	.....
50,000	.1291	.1224	Present diameter of stem, ".552.
52,000	.15	.....
54,000	.17	.....
56,000	.20	.....
58,000	.24	.....
60,000	.30	.....
62,000	.39	.....
63,800	.62	.....	Tensile strength.
0	.86	.....	=28.7 per cent.

Load on bar at time of fracture, 13,200 pounds=129,670 pounds per square inch on area at fracture.

Elongation of inch sections, "48", ".20, ".18.

Diameter at fracture, ".36; area, .1018 square inches.

Contraction of area, 59.3 per cent.

Fractured ".75 from the neck.

Appearance of fracture, fine silky.

No. 7893.

Heated white hot (expansion, ".112 in 7".25), cooled to cherry red (expansion now ".054 in 7".25), then drawn down under the hammer at latter temperature. Reduction, 49.8 per cent.

Quenched in oil.

Marks, 18.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	0.	
20,000	.0018	0.	
30,000	.0028	0.	
35,000	.0033	0.	
40,000	.0038	0.	
50,000	.0048	0.	
55,000	.0053	0.	
60,000	.0058	0.	
63,000	.0061	0.	
64,000	.....	.....	Elastic limit. Load fell.
57,000	.0130	.....
58,000	.0140	.....
59,000	.0163	.....
60,000	.0220	.0164	Present diameter of stem, ".560.
61,000	.0237	.....
62,000	.0578	.....
63,000	.0596	.....
64,000	.0631	.....
66,000	.0722	.....
68,000	.0826	.....
70,000	.0948	.0856	Present diameter of stem, ".555.
72,000	.11	.....
74,000	.12	.....
76,000	.14	.....
78,000	.17	.....
80,000	.20	.....
82,000	.23	.....
84,000	.32	.....
84,160	.40	.....	Tensile strength.
0	.68	.....	=22 per cent.

Load on bar at time of rupture, 16,400 pounds = 161,100 pounds per square inch on area at fracture.

Elongation of inch sections, ".14, ".11, ".41*.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 59.3 per cent.

Fractured ".50 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7894.

Heated white hot (expansion, ".115 in 7".25), cooled to blood red (expansion now ".050 in 7".25), then drawn down under the hammer at latter temperature. Reduction, 49.8 per cent.

Cooled in the open air.

Marks, 19.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0008	.....
20,000	.0019	.....
30,000	.0029	.....
40,000	.0038	0.	Elastic limit. Load fell.
50,000	.0049	0.	
51,000	.0050	.....
52,000	.....	.....
42,000	.0124	.....
43,000	.0145	.....
44,000	.0265	.....
45,000	.0578	.....
46,000	.0798	.....
47,000	.0844	.....
48,000	.0908	.....
50,000	.1040	.0974	
52,000	.12	.....
54,000	.14	.....
56,000	.16	.....
58,000	.18	.....
60,000	.22	.....
62,000	.26	.....
64,000	.32	.....
66,000	.49	.....
66,400	.64	Tensile strength.
0	.99	=33 per cent.

Elongation of inch sections, ".24, ".29, ".46*.

Diameter at fracture, ".38; area, .1134 square inch.

Contraction of area, 54.6 per cent.

Fractured 1".1 from the neck.

Appearance of fracture, silky, oblique.

No. 7895.

Heated white hot (expansion, ".120 in 7".25), cooled to blood red (expansion now ".040 in 7".25), then drawn down under the hammer at latter temperature. Reduction, 50.2 per cent.

Cooled in sand.

Marks, 20.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	.....
10,000	.0008	.....
20,000	.0018	.....
30,000	.0028	.....
40,000	.0038	0.	
49,000	.0047	.....
50,000	.....	.....	Elastic limit. Load fell.
44,000	.0084	.....
45,000	.0132	.....
46,000	.0655	.....
47,000	.0738	.....
48,000	.0794	.....
49,000	.0829	.....
50,000	.0911	.0647	
52,000	.11	.....
54,000	.13	.....
56,000	.14	.....
58,000	.16	.....
60,000	.19	.....
62,000	.22	.....
64,000	.27	.....
66,000	.33	.....
68,000	.47	.....
68,080	.59	.....	Tensile strength
0	.87	.....	= 29 per cent.

Load on bar at time of rupture, 13,600 pounds = 126,510 pounds per square inch on area at fracture.

Elongation of inch sections, ".15, ".50*, ".22.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Fractured 1".7 from the neck.

Appearance of fracture, fine silky.

No. 7896.

Heated white hot (expansion, ".126 in 7".25), cooled to blood red (expansion now ".052 in 7".25), then drawn down under the hammer at latter temperature. Reduction, 50.2 per cent.

Quenched in oil.

Marks, 21.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0008	.....
20,000	.0018	.....
30,000	.0028	.....
40,000	.0037	0.	
50,000	.0048	0.	
55,000	.0054	.....
56,000	.0056	.....
57,000	.....	.....	Elastic limit. Load fell.
54,000	.0080	.....
55,000	.0116	.....
56,000	.0402	.....
57,000	.0427	.....
58,000	.0471	.....
59,000	.0514	.....
60,000	.0571	.0495	Present diameter of stem, ".558.
62,000	.0623	.....
64,000	.0765	.....
66,000	.0867	.....
68,000	.0995	.....
70,000	.1156	.1063	Present diameter of stem, ".558.
72,000	.13	.....
74,000	.16	.....
76,000	.19	.....
78,000	.23	.....
80,000	.29	.....
80,640	.43	.....	Tensile strength.
0	.71	.....	=23.7 per cent.

Load on bar at time of rupture, 15,200 pounds = 158,000 pounds per square inch on area at fracture.

Elongation of inch sections, ".41", ".17", ".13.

Diameter at fracture, ".35; area, .0962 square inch.

Contraction of area, 61.5 per cent.

Fractured 1" from the neck.

Appearance of fracture, fine silky.

No. 7897.

Heated to a low yellow (expansion, ".102 in 7".25), and drawn down under the hammer at same temperature. Reduction, 20 per cent.

Cooled in air.

Marks, 22.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0006	.....
20,000	.0019	.....
30,000	.0029	0.	
40,000	.0039	0.	
41,000	.0040	.....	Elastic limit. Load fell.
42,000	.0042	.....
38,000	.0107	.....
39,000	.0192	.....
40,000	.0610	.....
41,000	.0640	.....
42,000	.0667	.....
43,000	.0713	.....
44,000	.0786	.....
45,000	.0835	.....
46,000	.0909	.....
48,000	.1067	.....
50,000	.1283	.1169	
52,000	.14	.....
54,000	.16	.....
56,000	.19	.....
58,000	.23	.....
60,000	.27	.....
62,000	.35	.....
63,840	.56	.....	Tensile strength.
0	.73	.....	= 24.3 per cent.

Load on bar at time of rupture, 13,200 pounds = 95,310 pounds per square inch on area at fracture.

Elongation of inch sections, ".13, ".30*, ".30.

Diameter at fracture, ".42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Fractured 1".40 from the neck.

Appearance of fracture, silky, oblique, irregular surface.

No. 7898.

Heated to a low yellow (expansion, ".085 in 7".25), and drawn down under the hammer at same temperature. Reduction, 19.6 per cent.

Cooled in sand.

Marks, 23.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0029	.....
40,000	.0039	0.	Elastic limit.
41,000	.0042	.....	Load fell.
36,000	.0111	.....
37,000	.0119	.....
38,000	.0541	.....
39,000	.0557	.....
40,000	.0592	.0544	Present diameter of stem, ".568.
41,000	.0625	.....
42,000	.0677	.....
44,000	.0794	.....
46,000	.0938	.....
48,000	.1061	.....
50,000	.1265	.1199	Present diameter of stem, ".552.
52,000	.15	.....
54,000	.17	.....
56,000	.20	.....
58,000	.28	.....
60,000	.28	.....
62,000	.35	.....
63,440	.48	.....	} Tensile strength. = 25.7 per cent.
0	.57	.....
	.77	.....

Elongation of inch sections, ".19, ".39*, ".19.

Diameter at fracture, ".41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Fractured 1".5 from the neck.

Appearance of fracture, silky.

No. 7899.

Heated to a low yellow (expansion, ".084 in 7".25), and drawn down under the hammer at same temperature. Reduction, 21.3 per cent.

Quenched in oil.

Marks, 24.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0004	0.		
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0029	0.		
40,000	.0040	.....	
45,000	.0045	.....	
50,000	.0060	.0001		Elastic limit.
51,000	.0068	.....	
52,000	.0065	.....	
53,000	.0072	.....	
54,000	.0146	.....	
55,000	.0220	.....	
56,000	.0252	.....	
57,000	.0275	.....	
58,000	.0310	.....	
60,000	.0384	.0312		
62,000	.0450	.....	
64,000	.0588	.....	
66,000	.0625	.....	
68,000	.0712	.....	
70,000	.0817	.0726		
72,000	.09	.....	
74,000	.10	.....	
76,000	.12	.....	
78,000	.15	.....	
80,000	.18	.....	
82,000	.21	.....	
84,000	.27	.....	
84,400	Tensile strength. =16.3 per cent.	
0	.49	.....	

Elongation of inch sections, ".28*"; ".11, ".10.

Diameter at fracture, ".42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Fractured 1" from the neck.

Appearance of fracture, silky, oblique, irregular surface.

No. 7900.

Heated to a low yellow (expansion, ".090 in 7".25), and drawn down under the hammer at same temperature. Reduction, 26.2 per cent.

Cooled in the open air.

Marks, 25.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	.....
20,000	.0018	.....
30,000	.0029	.....
40,000	.0039	0.	Elastic limit. Load fell.
41,000	.....	.....
38,000	.0088	.....
39,000	.0210	.....
40,000	.0580	.....
42,000	.0627	.....
44,000	.0728	.....
46,000	.0818	.....
48,000	.0960	.....
50,000	.1096	.1084	
52,000	.13	.....
54,000	.15	.....
56,000	.17	.....
58,000	.20	.....
60,000	.24	.....
62,000	.29	.....
64,000	.37	.....
64,880	Tensile strength. =24.3 per cent.
0	.73	.....

Load on bar at time of rupture, 13,600 pounds=126,510 pounds per square inch on area at fracture.

Elongation of inch sections, ".16, ".42*, ".15.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Fractured 1".48 from the neck.

Appearance of fracture, silky, oblique.

No. 7901.

Heated to a low yellow (expansion, ".093 in 7".25), and drawn down under the hammer at same temperature. Reduction, 30.2 per cent.

Cooled in sand.

Marks, 26.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	.....
40,000	.0041	.0001	Elastic limit. Load fell.
41,000	.....	.....
37,000	.0079	.....
38,000	.0520	.....
39,000	.0540	.....
40,000	.0585	.0588	
41,000	.0609	.....
42,000	.0660	.....
44,000	.0789	.....
46,000	.0908	.....
48,000	.1060	.....
50,000	.1190	.1125	
52,000	.14	.....
54,000	.16	.....
56,000	.19	.....
58,000	.22	.....
60,000	.26	.....
62,000	.32	.....
64,000	.43	.....
65,040	.62	.....	Tensile strength.
0	.92	.....	=30.7 per cent.

Load on bar at time of fracture, 13,600 pounds=119,930 pounds per square inch on area at fracture.

Elongation of inch sections, ".24, ".47*, ".21.

Diameter at fracture, ".38; area, .1134 square inch.

Contraction of area, 54.6 per cent.

Fractured 1".55 from the neck.

Appearance of fracture, fine, silky.

No. 7902.

Heated to a low yellow (expansion, ".095 in 7".25), and drawn down under the hammer at same temperature. Reduction, 32 per cent.

Quenched in oil.

Marks, 27.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0031	.....
40,000	.0041	0.	
45,000	.0046	.....
50,000	.0051	0.	
53,000	.0056	.....
54,000	.0058	.....		Elastic limit.
55,000	.0060	.....	Load fell.
53,000	.0069	.....
54,000	.0185	.....
55,000	.0240	.....
56,000	.0276	.....
58,000	.0339	.....
60,000	.0410	.0685	
62,000	.0473	.....
64,000	.0561	.....
66,000	.0644	.....
68,000	.0740	.....
70,000	.0850	.0760	
72,000	.10	.....
74,000	.11	.....
76,000	.18	.....
78,000	.14	.....
80,000	.17	.....
82,000	.20	.....
84,000	.27	.....
85,200	.37	.....	Tensile strength.
0	.60	.....	= 20 per cent.

Load on bar at time of rupture, 16,300 pounds=160,120 pounds per square inch on area at fracture.

Elongation of inch sections, ".38*", ".11, ".11.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 59.3 per cent.

Fractured ".65 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7903.

Heated to a low yellow (expansion ".097 in 7".25), and drawn down under the hammer at same temperature. Reduction, 47.1 per cent.

Cooled in sand.

Marks, 28.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	.....
20,000	.0018	.....
30,000	.0028	0.	
40,000	.0039	.....	Elastic limit. Load fell.
36,000	.0058	.....
37,000	.0072	.....
38,000	.0114	.....
39,000	.0559	.....
40,000	.0596	.0645	
41,000	.0615	.....
42,000	.0669	.....
43,000	.0715	.....
44,000	.0800	.....
46,000	.0905	.....
48,000	.1059	.....
50,000	.1210	.1148	
52,000	.14	.....
54,000	.16	.....
56,000	.19	.....
58,000	.22	.....
60,000	.27	.....
62,000	.35	.....
64,000	.49	.....
64,480	.70	.....	Tensile strength.
0	1.08	.....	=34.3 per cent.

Load on bar at time of rupture, 12,900 pounds=120,000 pounds per square inch on area at fracture.

Elongation of inch sections, ".52*", ".30, ".21.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Fractured ".75 from the neck.

Appearance of fracture, fine silky.

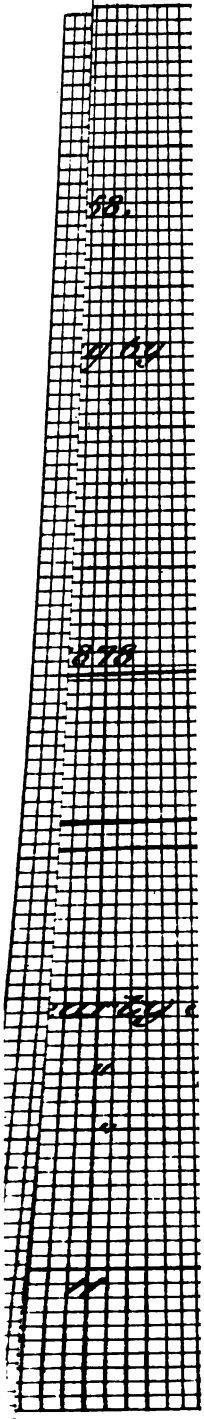
TABULATION OF TENSION SPECIMENS FROM 16" BY 18' CARBON STEEL INGOT.
 FORGED SPECIMENS—SQUARE BARS DRAWN DOWN TO SQUARE BARS AT DIFFERENT TEMPERATURES.

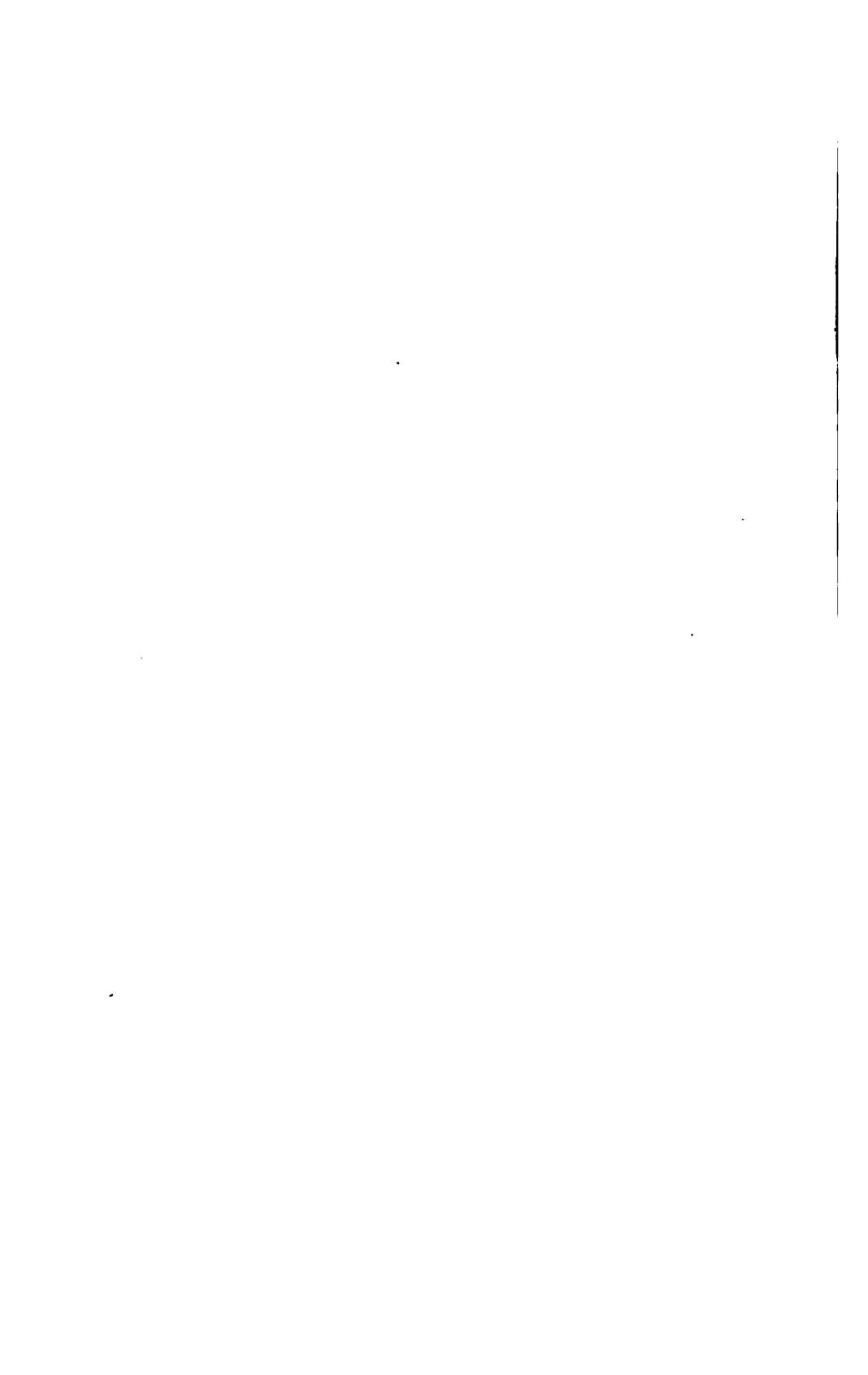
STEMS OF SPECIMENS, ".564 DIAMETER, 3" LONG.

No. of test.	Treatment.	Reduction.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3".	Contraction of inch sections.		Appearance of fracture.
						Per cent.	" "	
7876	Heated white hot and drawn down under the hammer at same. Cooled in open air.	52.0	48,000	66,480	34.3	Per cent. 61.5	".77, .52*, .24	Fine silky, cup-shaped.
7877	Heated, white hot and drawn down under the hammer at same. Cooled in sand.	52.9	38,000	62,480	30.7	61.5	.45*, .25, .22	Do.
7878	Heated white hot and drawn down under the hammer at same. Quenched in oil.	49.8	51,000	85,200	20.0	63.7	.10, .20, .30*	Do.
7879	Heated bright yellow and drawn down under the hammer at same. Cooled in open air.	50.7	41,000	66,080	28.0	59.3	.19, .40*, .25	Do.
7880	Heated bright yellow and drawn down under the hammer at same. Cooled in sand.	50.2	40,000	64,800	27.0	59.3	.16, .43*, .22	Do
7881	Heated bright yellow and drawn down under the hammer at same. Quenched in oil.	48.9	52,000	81,280	25.7	63.7	.32*, .28, .17	Do.
7882	Heated low yellow and drawn down under the hammer at same. Cooled in open air.	51.6	44,600	67,200	27.0	57.0	.46*, .19, .16	Do.
7883	Heated low yellow and drawn down under the hammer at same. Cooled in sand.	52.0	38,000	63,040	32.7	57.0	.50*, .27, .21	Do.
7884	Heated low yellow and drawn down under the hammer at same. Quenched in oil.	48.4	53,000	78,880	21.3	61.5	.10, .41*, .13	Do.
7885	Heated cherry and drawn down under the hammer at same. Cooled in open air.	48.4	44,000	66,560	26.7	59.3	.19, .48*, .13	Do.
7886	Heated cherry and drawn down under the hammer at same. Cooled in sand.	52.0	40,000	65,120	28.3	57.0	.17, .34*, .34*	Do.
7887	Heated cherry and drawn down under the hammer at same. Quenched in oil.	50.2	55,000	78,800	24.3	63.7	.12, .16, .45*	Do.
7888	Heated blood red and drawn down under the hammer at same. Cooled in open air.	49.8	48,000	64,600	23.7	41.9	.34*, .23, .14	Silky, oblique.
7889	Heated blood red and drawn down under the hammer at same. Cooled in sand.	52.0	51,000	66,960	29.7	59.3	.15, .25, .49*	Fine silky, cup-shaped.
7890	Heated blood red and drawn down under the hammer at same. Quenched in oil.	51.6	55,000	79,280	23.3	61.5	.07, .16, .47*	Do.
7891	Heated white hot, cooled to cherry red, then drawn down under hammer at latter temperature. Cooled in open air.	52.4	48,000	66,560	27.7	61.5	.14, .49*, .20	Do.
7892	Heated white hot, cooled to cherry red, then drawn down under hammer at latter temperature. Cooled in sand.	53.8	46,500	63,600	28.7	59.3	.49*, .20, .18	Fine silky.

TABULATION OF TENSION SPECIMENS FROM 16" BY 18" CARBON STEEL INGOT—Continued.
 FORGED SPECIMENS—SQUARE BARS DRAWN DOWN TO SQUARE BARS AT DIFFERENT TEMPERATURES—Continued.
 STEMS OF SPECIMENS, ".564 DIAMETER, 3' LONG—Continued.

No. of test.	Treatment.	Reduction.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3".	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Per cent.	Pounds.	Pounds.	Per cent.	Per cent.	" "	
7888	Heated white hot, cooled to cherry red, then drawn down under hammer at latter temperature. Quenched in oil.	49.8	64,000	84,160	22.0	59.3	" "	Fine silky, cup-shaped.
7894	Heated white hot, cooled to blood red, then drawn down under hammer at latter temperature. Cooled in open air.	43.8	52,000	66,400	33.0	54.6	.14, .11, .41*	Silky, oblique.
7896	Heated white hot, cooled to blood red, then drawn down under hammer at latter temperature. Cooled in sand.	50.2	50,000	68,080	29.0	57.0	.24, .29, .46*	Fine silky.
7896	Heated white hot, cooled to blood red, then drawn down under hammer at latter temperature. Quenched in oil.	50.2	57,000	80,640	23.7	61.5	.15, .50*, .22	Do.
7897	Heated low yellow and drawn down under the hammer at same. Cooled in air.	22.0	42,000	63,940	24.3	44.6	.41*, .17, .13	Silky, oblique, irregular surface.
7898	Heated low yellow and drawn down under the hammer at same. Cooled in sand.	19.6	40,000	63,440	25.7	47.2	.13, .30*, .30	Silky.
7899	Heated low yellow and drawn down under the hammer at same. Quenched in oil.	21.3	50,000	84,400	16.3	44.6	.19, .39*, .19	Silky, oblique, irregular surface.
7900	Heated low yellow and drawn down under the hammer at same. Cooled in open air.	26.2	41,000	64,880	24.3	57.0	.28*, .11, .10	Silky, oblique.
7901	Heated low yellow and drawn down under the hammer at same. Cooled in sand.	30.2	41,000	65,040	30.7	54.6	.16, .42*, .15	Fine silky.
7902	Heated low yellow and drawn down under the hammer at same. Quenched in oil.	32.0	54,000	85,200	20.0	56.3	.24, .47*, .21	Fine silky, cup-shaped.
7903	Heated low yellow and drawn down under the hammer at same. Cooled in sand.	47.1	40,000	64,480	34.3	57.0	.38*, .11, .11	Fine silky.
							.52*, .30, .21	





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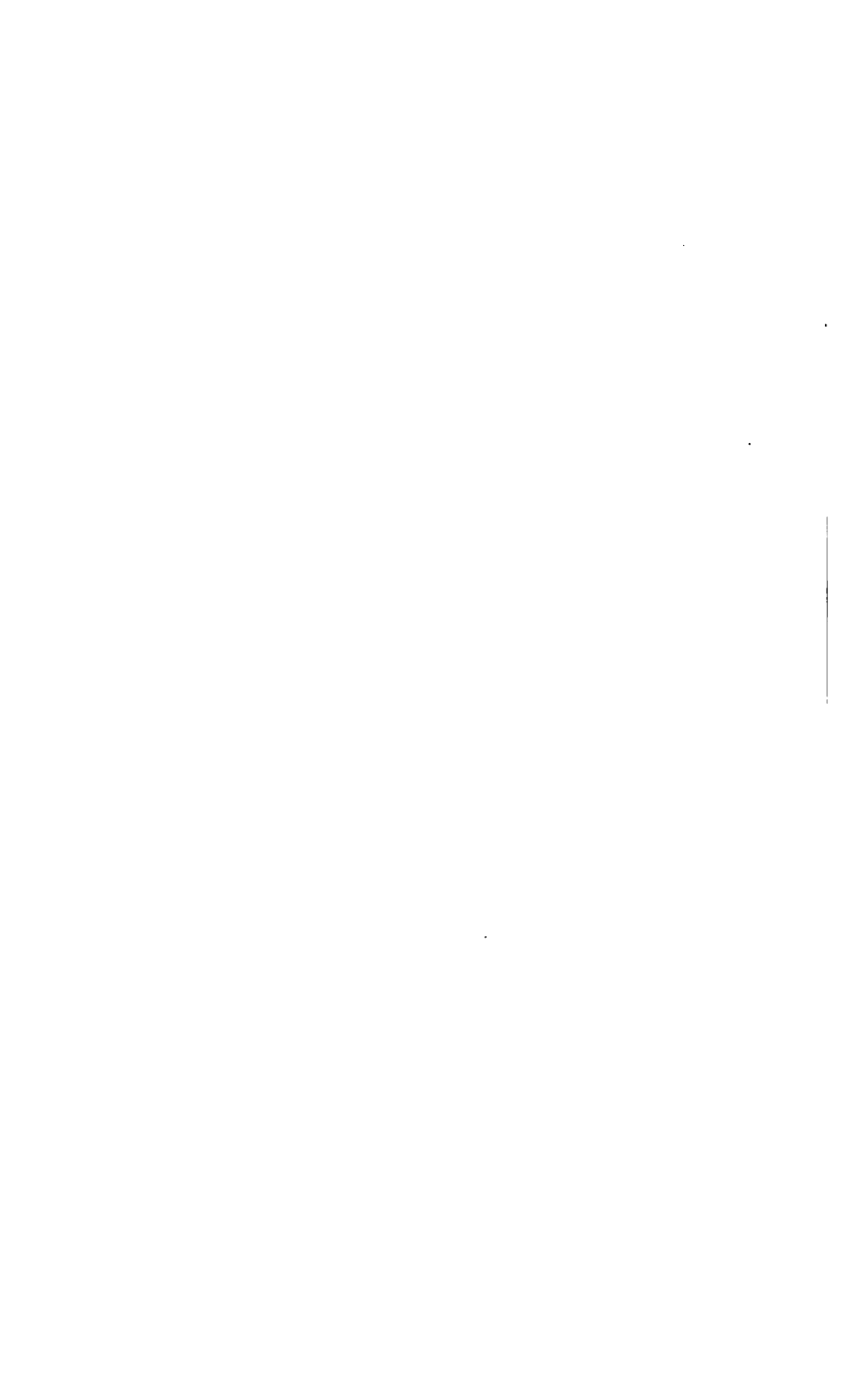
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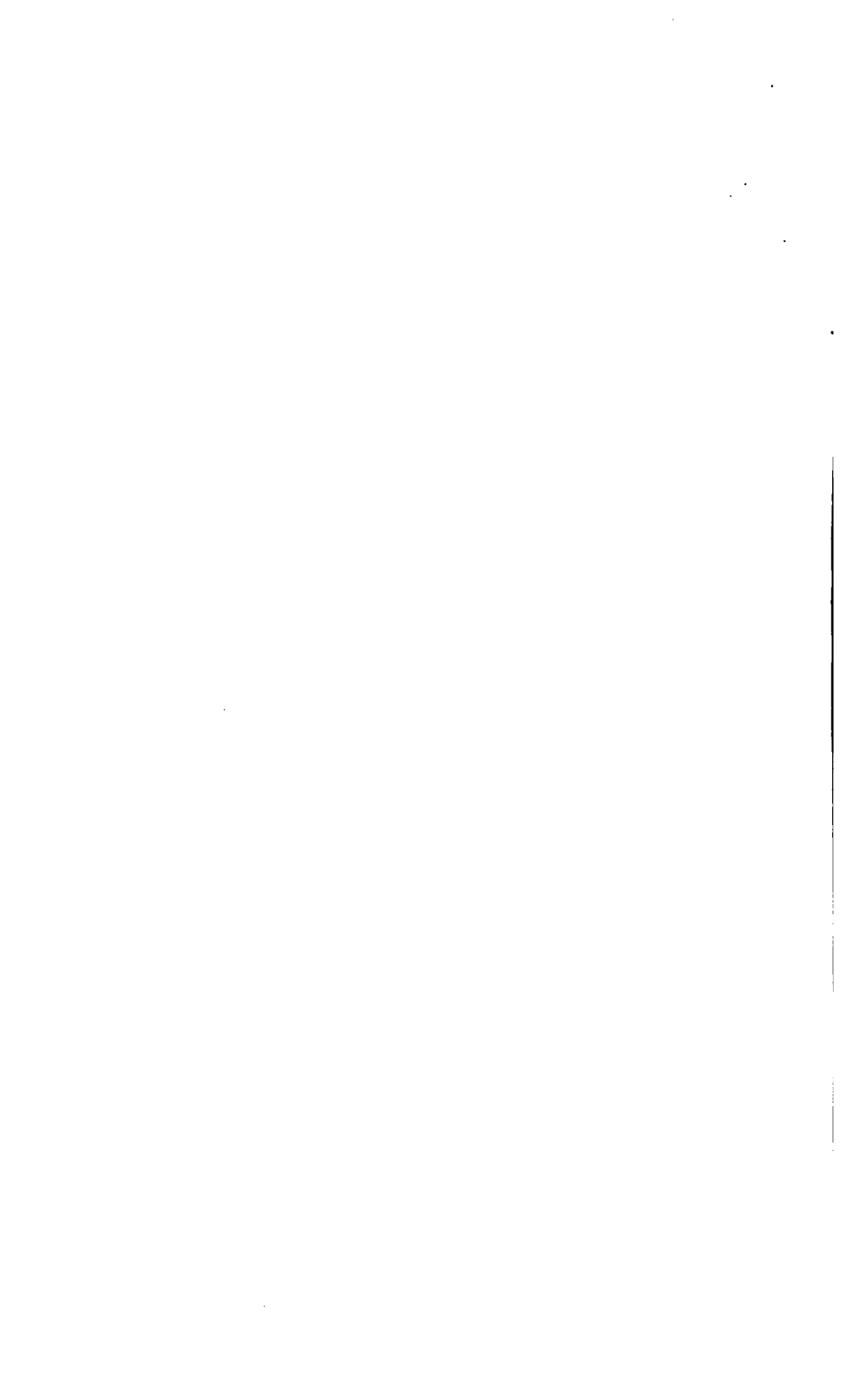
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16" BY 18" CARBON STEEL INGOT.

(See Report of 1902, cut No. 8, following p. 204.) Block forged in Arsenal smith shop into form of cylindrical hoop, at a forging heat. Three tangential specimens, Nos. 1, 2, and 3, taken from a ring cut out of the hoop.

No. 7871.

Marks, 1.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0084	.0003	Elastic limit.
31,000	.....	.....	Load fell.
28,000	.0068	.....
29,000	.0084	.....
30,000	.0138	.....
31,000	.0212	.....
32,000	.0401	.....
33,000	.0464	.....
34,000	.0497	.....
35,000	.0555	.....
36,000	.0567	.....
38,000	.0687	.....
40,000	.0810	.....
42,000	.10	.....
44,000	.11	.....
46,000	.12	.....
48,000	.14	.....
50,000	.16	.....
52,000	.20	.....
54,000	.28	.....
56,000	.28	.....
58,000	.35	.....
60,000	.52	.....
60,400	.....	.....	Tensile strength.
0	.85	.....	=28.3 per cent.

Load on bar at time of rupture, 12,000 pounds=111,630 pounds per square inch on area at fracture.

Elongation of inch sections, ".15, ".44*, ".26.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Fractured 1".48 from the neck.

Appearance of fracture, fine silky.

No. 7872.

Marks, 2.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0020	.....
28,000	.0029	.....
29,000	.0030	.....
30,000	.0032	.0001	
31,000	.0033	.....
32,000	.....	.....	Elastic limit. Load fell.
37,000	.0065	.....
38,000	.0125	.....
39,000	.0157	.....
39,000	.0179	.....
31,000	.0247	.....
34,000	.0500	.....
36,000	.0704	.....
38,000	.0813	.....
40,000	.0948	.....
42,000	.12	.....
44,000	.14	.....
46,000	.16	.....
48,000	.18	.....
50,000	.20	.....
52,000	.23	.....
54,000	.29	.....
54,400	.....	.....	Tensile strength.
0	.38	.....	=12.7 per cent.

Elongation of inch sections, ".10, ".09, ".19*.

Diameter at fracture, ".51; area, .2043 square inch.

Contraction of area, 18.3 per cent.

Fractured 1".1 from the neck.

Appearance of fracture, dull gray, amorphous, irregular surface.

No. 7873.

Marks, 3.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0020	.....
25,000	.0029	.....
29,000	.0081	.....
30,000	.0082	0.	
31,000	.0083	.....
31,800	.....	.....	Elastic limit. Load fell.
29,000	.0083	.....
30,000	.0102	.....
31,000	.0143	.....
32,000	.0468	.....
35,000	.0478	.....
34,000	.0516	.....
36,000	.0628	.....
38,000	.0725	.....
40,000	.0856	.....
42,000	.10	.....
44,000	.11	.....
46,000	.13	.....
48,000	.14	.....
50,000	.17	.....
52,000	.20	.....
54,000	.24	.....
56,000	.29	.....
58,000	.36	.....
60,000	.60	.....	Tensile strength.
0	.87	.....	=29 per cent.

Elongation of inch sections, ".17, ".38*, ".32.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 59.3 per cent.

Fracture 1".68 from the neck.

Appearance of fracture, fine silky.

METAL FROM 16" BY 18" NICKEL-STEEL INGOT.

UNFORGED SPECIMENS AFTER HEAT TREATMENT OF THE STEEL.

No. 7642.

Heated to a straw color, cooled in dry sand. Subsequently heated to 500° F. \pm in hot oil for a period of four hours.

Marks, N2, A'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0006	0.	
10,000	.0012	0.	
15,000	.0018	0.	
20,000	.0023	0.	
25,000	.0029	0.	
30,000	.0035	0.	
34,000	.0040	.....	Elastic limit.
35,000	.0045	.0008	
36,000	.0052	.....
37,000	.0061	.....
38,000	.0070	.....
39,000	.0088	.....
40,000	.0129	.0081	
41,000	.0155	.....
42,000	.0225	.....
44,000	.0330	.....
46,000	.0445	.....
48,000	.0576	.....
50,000	.0710	.0650	
52,000	.0890	.....
54,000	.1040	.....
56,000	.1280	.....
58,000	.16	.....
60,000	.19	.....
62,000	.23	.....
64,000	.30	.....
66,000	.48	.....
66,400	.....	.....	Tensile strength.
0	.65	.....	= 21.7 per cent.

Elongation of inch sections, ".17, ".32*, ".16.

Diameter at fracture, ".45; area, .1590 square inch.

Contraction of area, 36.4 per cent.

Appearance of fracture, dull silky, oblique.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN N2-B', NO. 7643, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BLUE AND COOLED IN DRY SAND.

No. 7643.

Heated to a blue, cooled in dry sand.

Marks, N2, B'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	0.	
15,000	.0015	0.	
20,000	.0020	0.	
25,000	.0024	0.	
30,000	.0031	0.	
31,000	.0032	.....
32,000	.0033	.....
33,000	.0036	.....
34,000	.0039	.....
35,000	.0041	.0003	Elastic limit.
36,000	.0051	.....
37,000	.0060	.....
38,000	.0070	.....
39,000	.0085	.....
40,000	.0148	.0100	
42,000	.0240	.....
44,000	.0380	.....
46,000	.0468	.....
48,000	.0580	.....
50,000	.0720	.0661	
52,000	.0900	.....
54,000	.1075	.....
56,000	.1280	.....
58,000	.16	.....
60,000	.20	.....
62,000	.25	.....
64,000	.31	.....
66,000	.....	.....	Tensile strength.
0	.64	.....	= 21.3 per cent.

Elongation of inch sections, ".15, ".33*, ".16.

Diameter at fracture, ".45; area, .1590 square inch.

Contraction of area, 36.4 per cent.

Appearance of fracture, dull amorphous, varying in color.

No. 7644.

Heated red and cooled in dry sand.
 Marks, N 2, C'.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0011	0.	
15,000	.0017	0.	
20,000	.0022	0.	
25,000	.0028	0.	
30,000	.0033	0.	
35,000	.0041	.0002	Elastic limit.
36,000	.0047	.....
37,000	.0051	.....
38,000	.0060	.....
39,000	.0069	.....
40,000	.0109	.0061	Rested under initial load 4 hour.
42,000	.0189	.....
44,000	.0316	.....
46,000	.0430	.....
48,000	.0560	.....
50,000	.0721	.0660	
52,000	.0853	.....
54,000	.1023	.....
56,000	.1240	.....
58,000	.16	.....
60,000	.19	.....
62,000	.23	.....
63,200	.....	.....	Tensile strength.
0	.30	.....	=10 per cent.

Elongation of inch sections, ".08, ".10, ".12*.

Diameter at fracture, ".51; area, .2043 square inch.

Contraction of area, 18.3 per cent.

Appearance of fracture, granular 70 per cent, smooth dull leaden colored 30 per cent.

No. 7645.

Heated to a cherry and cooled in dry sand.

Marks, N2, D'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0016	0.	
20,000	.0021	0.	
25,000	.0028	0.	
30,000	.0037	.0001	
31,000	.0039	.....
32,000	.0040	.....
33,000	.0042	.....
34,000	.0046	Elastic limit.
35,000	.0050	.0010	
36,000	.0067	.....
37,000	.0060	.....
38,000	.0069	.....
39,000	.0075	.....
40,000	.0089	.0041	
41,000	.0100	.....
42,000	.0120	.....
43,000	.0142	.....
44,000	.0200	Tensile strength. =10.8 per cent.
45,000	.0258	.0201	
46,000	.0300	.....
48,000	.0440	.....
50,000	.0590	.0626	
52,000	.0670	.....
54,000	.0670	.....
56,000	.1000	.....
58,000	.12	.....
60,000	.15	.....
62,000	.19	.....
64,000	.....	.....
0	.31	.....

Elongation of inch sections, ".07, ".07, ".17*.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Defective specimen. Appearance of fracture, dull amorphous, oblique. Flattened cavity ".08 by ".20 with dark blue walls.

No. 7646.

Heated low yellow, cooled in dry sand.

Marks, N2, E'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3''.

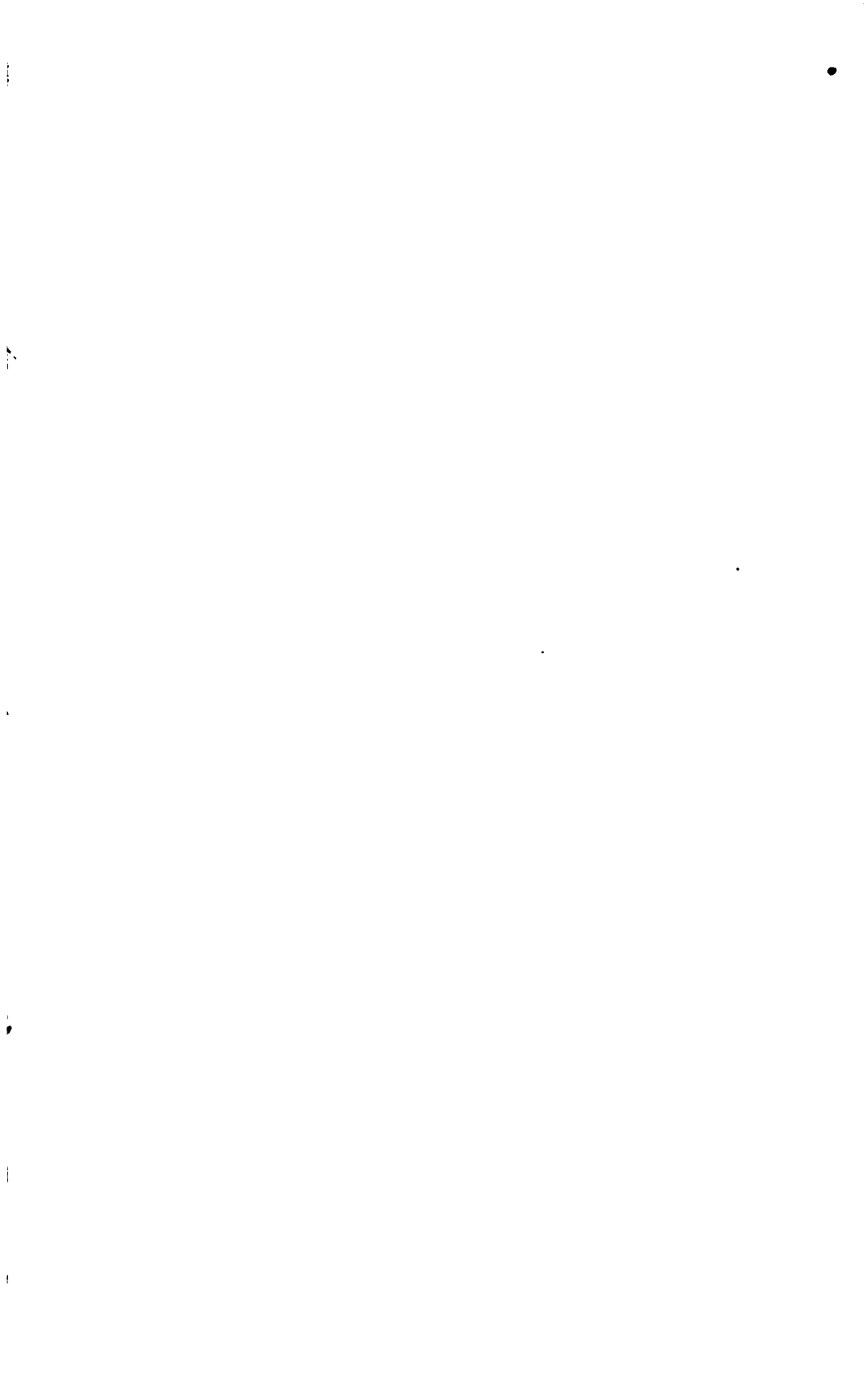
Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0016	0.	
20,000	.0021	0.	
25,000	.0023	0.	
30,000	.0035	0.	
35,000	.0040	0.	
40,000	.0046	0.	
45,000	.0050	0.	
50,000	.0057	0.	
54,000	.0062	.....	Elastic limit.
55,000	.0066	.0006	Load fell on second application, after observing set.
49,000	.0118	.....
50,000	.0160	.....
51,000	.0440	.....
52,000	.0685	.....
53,000	.0730	.....
54,000	.0800	.....
55,000	.0855	.....
56,000	.0915	.....
58,000	.1070	.....
60,000	.1235	.1158	
64,000	.18	.....
68,000	.25	.....
72,000	.44	.....
73,280	.....	.....	Tensile strength.
0	.81	.....	= 27 per cent.

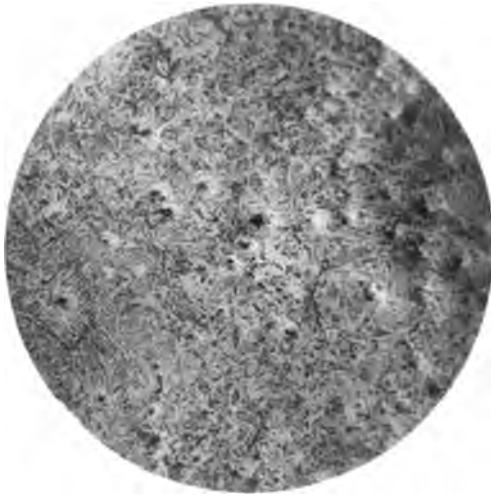
Elongation of inch sections, ".19, ".42*, ".20.

Diameter at fracture, ".40; area, .1257 square inch.

Contraction of area, 49.7 per cent.

Appearance of fracture, silky, oblique.





PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN N2-F', NO. 7647, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BRIGHT YELLOW AND COOLED IN DRY SAND.

No. 7647.

Heated bright yellow, cooled in dry sand.

Marks, N2, F'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0008	0.		
10,000	.0010	0.		
15,000	.0015	0.		
20,000	.0020	0.		
25,000	.0024	0.		
30,000	.0030	0.		
35,000	.0035	0.		
40,000	.0040	0.		
42,000	.0042	.....	
43,000	.0044	.....	
44,000	.0047	.....	
45,000	.0050	.0001		Elastic limit.
46,000	.0060		Load fell.
48,000	.0110		
44,000	.0192	.....	
45,000	.0293	.0240		
46,000	.0380	.....	
47,000	.0370	.....	
48,000	.0450	.....	
49,000	.0480	.....	
50,000	.0582	.0470		
52,000	.0625	.....	
54,000	.0777	.....	
56,000	.0900	.....	
58,000	.1072	.....	
60,000	.1245	.1168		
62,000	.14	.....	
64,000	.18	.....	
66,000	.22	.....	
68,000	.27	.....	
70,000	.35	.....	
71,600	.....	.....	Tensile strength.
0	.76	.....	=25.3 per cent.

Elongation of inch sections, ".19; ".39*, ".18.

Diameter at fracture, ".44; area, .1521 square inch.

Contraction of area, 39.2 per cent.

Appearance of fracture, oblique, shearing fracture; smooth, lustrous surface, with narrow band of lighter-colored metal.

No. 7648.

Heated white hot, and cooled in dry sand.

Marks, N2, G'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0016	0.	
20,000	.0021	0.	
25,000	.0026	0.	Elastic limit.
30,000	.0031	0.	
35,000	.0037	0.	
39,000	.0043	.....
40,000	.0050	.0008	
41,000	.0060	.....
42,000	.0080	.....
43,000	.0100	.....
44,000	.0131	.....
45,000	.0170	.0120	
46,000	.0206	.....
48,000	.0313	.....
50,000	.0427	.0367	
52,000	.0530	.....
54,000	.0650	.....
56,000	.0808	.....
58,000	.0940	.....
60,000	.1135	.1060	
62,000	.14	.....
64,000	.18	.....
66,000	.22	.....
67,600	Tensile strength.
0	.33	=11 per cent.

Elongation of inch sections, ".18*", ".07, ".08.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Defective specimen.

Appearance of fracture, oblique, shearing fracture; smooth, lustrous surface; seam of dark-colored metal at circumference ".25 by ".05.

No. 7649.

Raised to scintillating heat, cooled in dry sand.

Marks, N2, H'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0015	-----	
20,000	.0020	0.	
25,000	.0026	-----	
30,000	.0032	0.	
35,000	.0040	.0001	Elastic limit.
39,000	.0049	-----	
40,000	.0055	.0010	
41,000	.0060	-----	
42,000	.0070	-----	
43,000	.0078	-----	
44,000	.0092	-----	
45,000	.0106	.0062	
46,000	.0132	-----	
47,000	.0158	-----	
48,000	.0185	-----	
50,000	.0266	.0206	
52,000	.0340	-----	
54,000	.0480	-----	
56,000	.0617	-----	
58,000	.0780	-----	Three seams in stem opened.
60,000	.0915	.0840	
64,000	-----	-----	Tensile strength.
0	.21	-----	=7 per cent.

Elongation of inch sections, ".04, ".02, ".15*.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Defective specimen. Appearance of fracture, silky, oblique; parted at the principal seam in the stem; surface of seam smooth and bright.

No. 7650.

Heated white hot and quenched in oil.

Marks, N2, I'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0015	0.	
20,000	.0020	0.	
25,000	.0026	0.	
30,000	.0031	0.	
35,000	.0038	0.	
40,000	.0047	.0001	
45,000	.0052	0.	
50,000	.0060	.0006	
55,000	.0067	.0008	
60,000	.0073	.0010	
65,000	.0081	.0012	
70,000	.0090	.0015	
75,000	.0100	.0019	
80,000	.0110	.0022	
85,000	.0120	.0027	
90,000	.0130	.0031	
95,000	.0141	.0038	
100,000	.0157	.0048	
105,000	.0170	.0055	
110,000	.0190	.0068	
119,800	0	0	Tensile strength.
0	.03	0	=1 per cent.

Elongation of inch sections, ".02*", ".01, ".00.

Diameter at fracture, ".56; area, .2463 square inch.

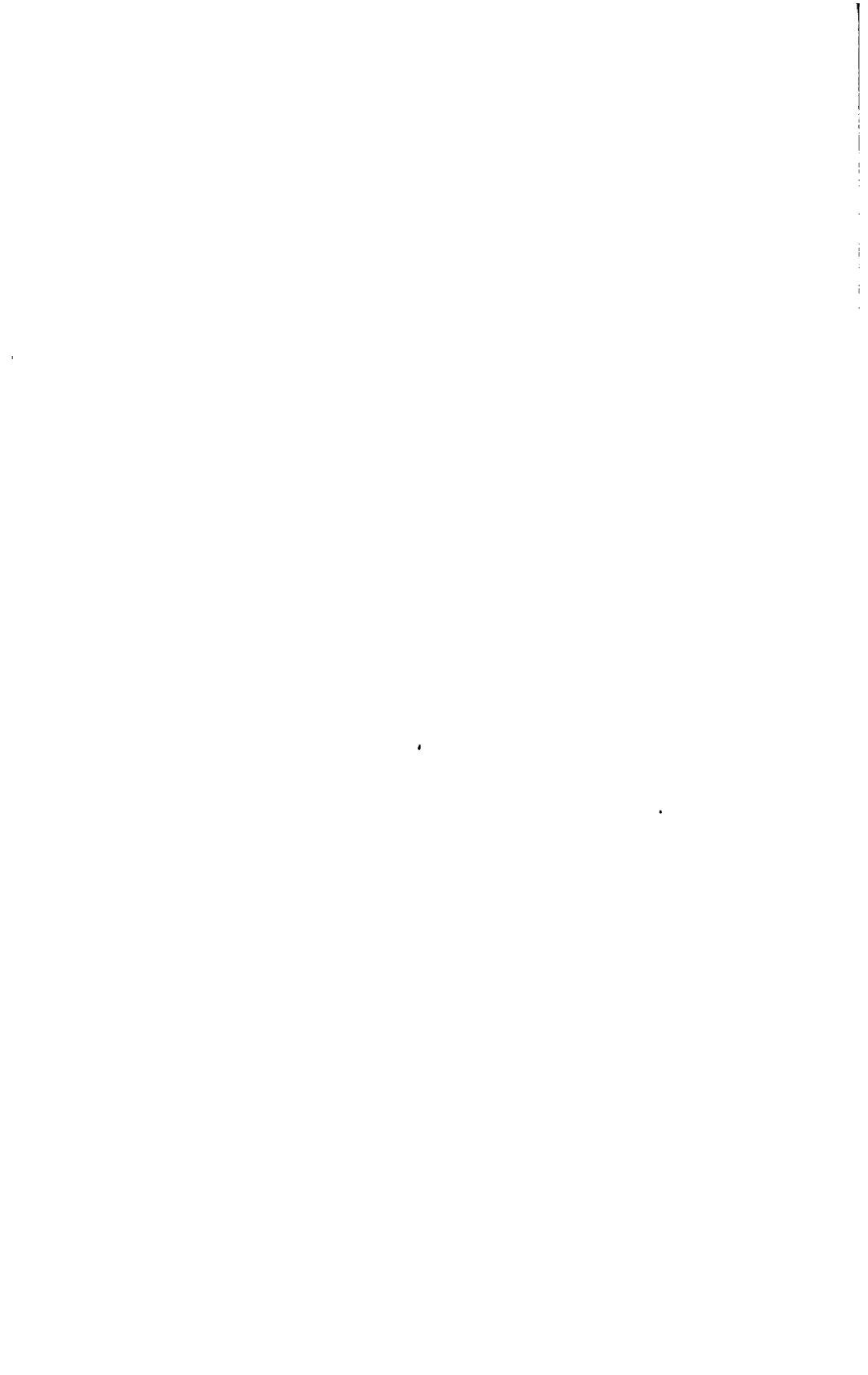
Contraction of area, 1.5 per cent.

Defective specimen. Appearance of fracture, fine granular; two small, bright, smooth spots.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN N2-1', NO. 7650, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT AND QUENCHED IN OIL.







PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN N2-J', NO. 7651, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT AND QUENCHED IN BRINE.

No. 7651.

Heated white hot and quenched in brine.
 Marks, N2, J'.
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0009	0.	
15,000	.0014	.....
20,000	.0020	0.	
25,000	.0026	.....
30,000	.0031	0.	
35,000	.0037	.....
40,000	.0042	0.	
45,000	.0048	0.	
50,000	.0053	0.	
55,000	.0060	.0001	
60,000	.0066	.0001	
65,000	.0072	.0002	
70,000	.0080	.0004	
75,000	.0088	.0006	
80,000	.0096	.0008	
85,000	.0102	.0010	
90,000	.0110	.0011	
95,000	.0119	.0013	
100,000	.0128	.0019	
105,000	.0136	.0021	
110,000	.0146	.0023	
120,000	.02	.....
130,000	.02+	.....
140,000	.03-	.....
150,000	.03	.....
160,000	.03+	.....
170,000	.04	.....
180,000	.06	.....
189,000	Tensile strength.
0	.18	=4.3 per cent.

Elongation of inch sections, ".03, ".07*, ".03.
 Diameter at fracture, ".48; area, .1810 square inch.
 Contraction of area, 9.5 per cent.
 Appearance of fracture, silky, interspersed with fine granulation.

No. 7652.

Heated white hot, quenched in oil, annealed at a straw color.
Marks, N2, K'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0010	0.	
20,000	.0020	0.	
30,000	.0031	0.	
35,000	.0036	.....
40,000	.0041	0.	
45,000	.0047	.....
50,000	.0052	0.	
55,000	.0060	.....
60,000	.0067	0.	
65,000	.0071	.....
70,000	.0079	.0002	
75,000	.0085	.....
80,000	.0091	.0006	
85,000	.0100	.....
90,000	.0106	.0009	
95,000	.0118	.....
100,000	.0120	.0012	
105,000	.0130	.....
110,000	.0140	.0020	
120,000	.02+	.....
130,000	.03-	.....
140,000	.03	.....
150,000	.04	.....
153,600	Tensile strength.
0	.04	= 1.3 per cent.

Elongation of inch sections, ".01, ".01, ".02*.

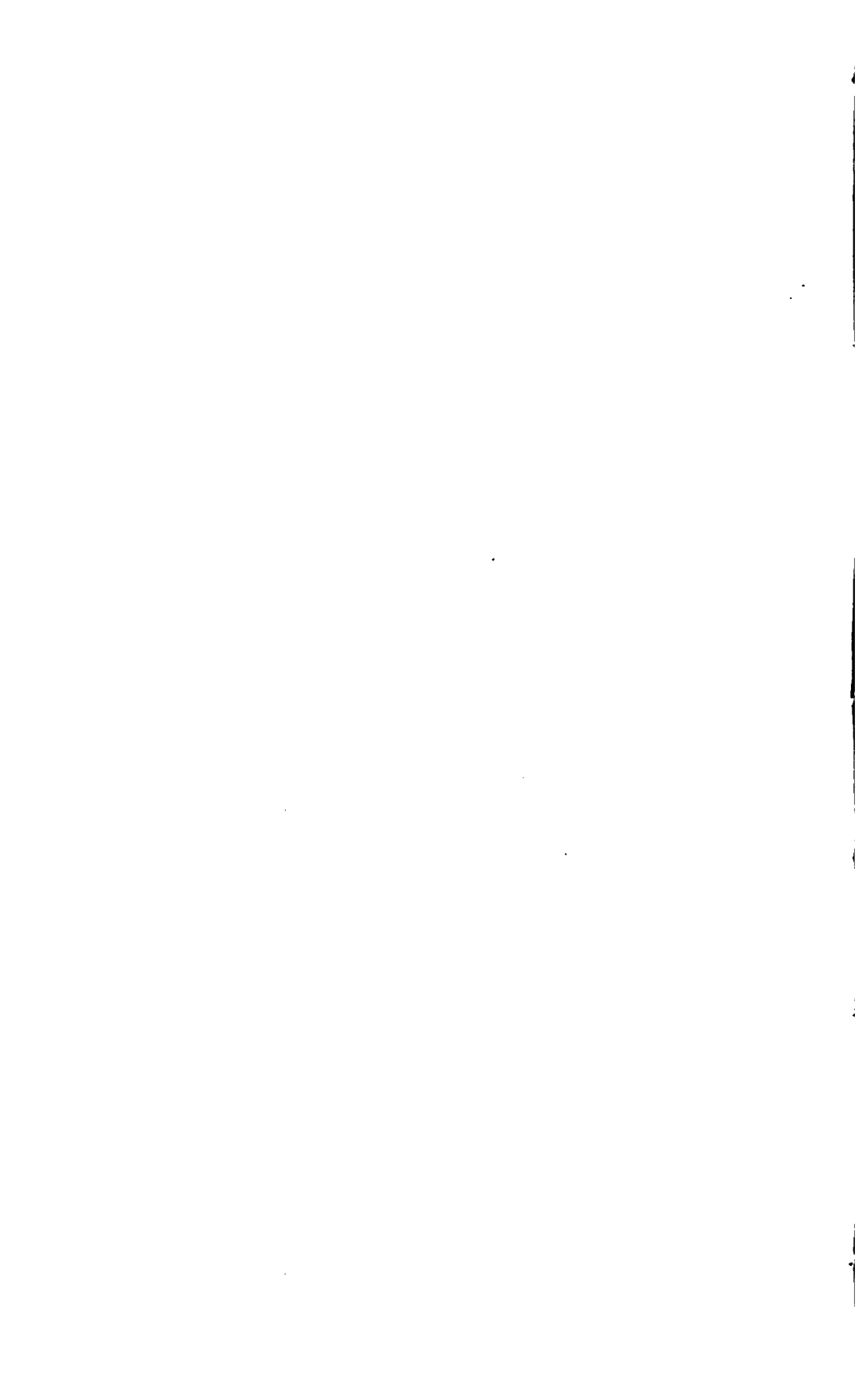
Diameter at fracture, ".55; area, .2376 square inch.

Contraction of area, 5 per cent.

Appearance of fracture, silky, interspersed with fine granulation; small, smooth, lustrous spot, ".10 by ".05.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN N2-K', NO. 7662, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT, QUENCHED IN OIL, AND ANNEALED AT STRAW COLOR.





PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN N2-L', NO. 7653, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT, QUENCHED IN OIL.
AND ANNEALED AT BLUE HEAT.

No. 7653.

Heated white hot, quenched in oil, annealed at blue heat.
 Marks, N2, L'.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0010	0.	
20,000	.0021	0.	
30,000	.0032	0.	
35,000	.0039	-----	
40,000	.0046	0.	
45,000	.0051	-----	
50,000	.0057	0.	
55,000	.0061	-----	
60,000	.0068	0.	
65,000	.0074	-----	
70,000	.0081	.0001	
75,000	.0088	-----	
80,000	.0094	.0005	
85,000	.0101	-----	
90,000	.0110	.0009	
95,000	.0118	-----	
100,000	.0128	.0012	
105,000	.0135	-----	
110,000	.0143	.0020	
120,000	.02	-----	
126,400	-----	-----	Tensile strength.
0	.03	-----	= 1 per cent.

Elongation of inch sections, ".01, ".02*, ".00.

Diameter at fracture, ".55; area, .2376 square inch.

Contraction of area, 5 per cent.

Appearance of fracture, silky and fine granulation interspersed.

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No. 7654.

Heated white hot, quenched in oil, annealed at bright cherry.
 Marks, N2, M'.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0004	0.		
10,000	.0010	0.		
20,000	.0021	0.		
30,000	.0031	0.		
35,000	.0037	.....	
40,000	.0042	0.		
45,000	.0047	.....	
50,000	.0052	0.		
51,000	.0053		Elastic limit.
52,000	.0079	.....	
51,000	.0098	.....	
52,000	.0135	.....	
53,000	.0149	.....	
54,000	.0167	.....	
52,000	.0465	.....	
53,000	.0608	Cracks in the stem open.	
54,000	.0758	.....	
56,000	.0825	.....	
60,000	.11	.....	
63,920	Tensile strength. = 7.3 per cent.	
0	.22	.....	

Elongation of inch sections, ".04, ".05, ".13*.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Defective specimen. Appearance of fracture, silky, oblique, 80 per cent; spot of smooth, lustrous metal, 20 per cent.

No. 7655.

Heated white hot, quenched in oil, annealed at bright yellow.

Marks, N2, N'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0011	0.	
20,000	.0022	0.	
30,000	.0032	0.	
35,000	.0038	Elastic limit.
40,000	.0048	0.	
45,000	.0060	.....
46,000	.0066	Cracks in stem opened.
47,000	.0070	.....
48,000	.0110	.....
49,000	.0390	.....
50,000	.0640	.....
60,000	.0590	.0625	Tensile strength. = 8.3 per cent.
56,000	.10	.....
60,000	.14	.....
68,600	.....	.....
0	.25	

Elongation of inch sections, ".05, ".07, ".13*.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Defective specimen. Appearance of fracture, silky, oblique; smooth, lustrous spots.

No. 7654.

Heated white hot, quenched in oil, annealed at bright cherry.

Marks, N2, M'.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
20,000	.0021	0.	
30,000	.0081	0.	
35,000	.0087	0.	
40,000	.0042	0.	
45,000	.0047	0.	
50,000	.0052	0.	
51,000	.0053	0.		Elastic limit.
52,000	.0079	0.	
51,000	.0098	0.	
52,000	.0135	0.	
53,000	.0149	0.	Cracks in the stem open.
54,000	.0167	0.	
52,000	.0465	0.	
53,000	.0608	0.	
54,000	.0758	0.	Tensile strength. = 7.3 per cent.
56,000	.0825	0.	
60,000	.11	0.	
63,920	.22	0.	

Elongation of inch sections, ".04, ".05, ".13*.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Defective specimen. Appearance of fracture, silky, oblique, 80 per cent; spot of smooth, lustrous metal, 20 per cent.

No. 7655.

Heated white hot, quenched in oil, annealed at bright yellow.
 Marks, N2, N'.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0011	0.	
20,000	.0022	0.	
30,000	.0032	0.	
35,000	.0038	.....
40,000	.0043	0.	
45,000	.0050	.....
46,000	.0056	.....
47,000	.0070	.....
48,000	.0110	Elastic limit.
48,000	.0390	.....
49,000	.0540	.....
50,000	.0590	.0625	
56,000	.10	Cracks in stem opened.
60,000	.14	.....
63,600	.....	.....
0	.25	.....
			Tensile strength. = 8.3 per cent.

Elongation of inch sections, ".05, ".07, ".13*.
 Diameter at fracture, ".50; area, .1964 square inch.
 Contraction of area, 21.4 per cent.
 Defective specimen. Appearance of fracture, silky, oblique; smooth, lustrous spots.

No. 7656.

Heated white hot, quenched in oil, annealed at white heat.
 Marks, N2, O'.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	0.	
20,000	.0020	0.	
30,000	.0030	0.	
35,000	.0036	0.	
40,000	.0041	0.	Elastic limit.
41,000	.0044	.....
42,000	.0050	.....
43,000	.0091	.....
44,000	.0160	.....
45,000	.0200	.0145	
46,000	.0280	.....
47,000	.0302	.....
48,000	.0342	.....
49,000	.0380	.....
50,000	.0448	.0883	
52,000	.0550	.....
54,000	.0655	.....
56,000	.0800	.....
58,000	.0940	.....
60,000	.1138	.1058	
62,000	.13	.....
64,000	.17	.....
66,000	.21	.....
68,000	.25	.....
70,000	.32	.....
71,680	.....	.....	Tensile strength.
0	.83	.....	= 27.7 per cent.

Elongation of inch sections, ".17, ".22, ".44*.
 Diameter at fracture, ".37; area, .1075 square inch.
 Contraction of area, 57 per cent.
 Appearance of fracture, fine silky.

no. 68, nickel 3.25.

res of tensile stress.

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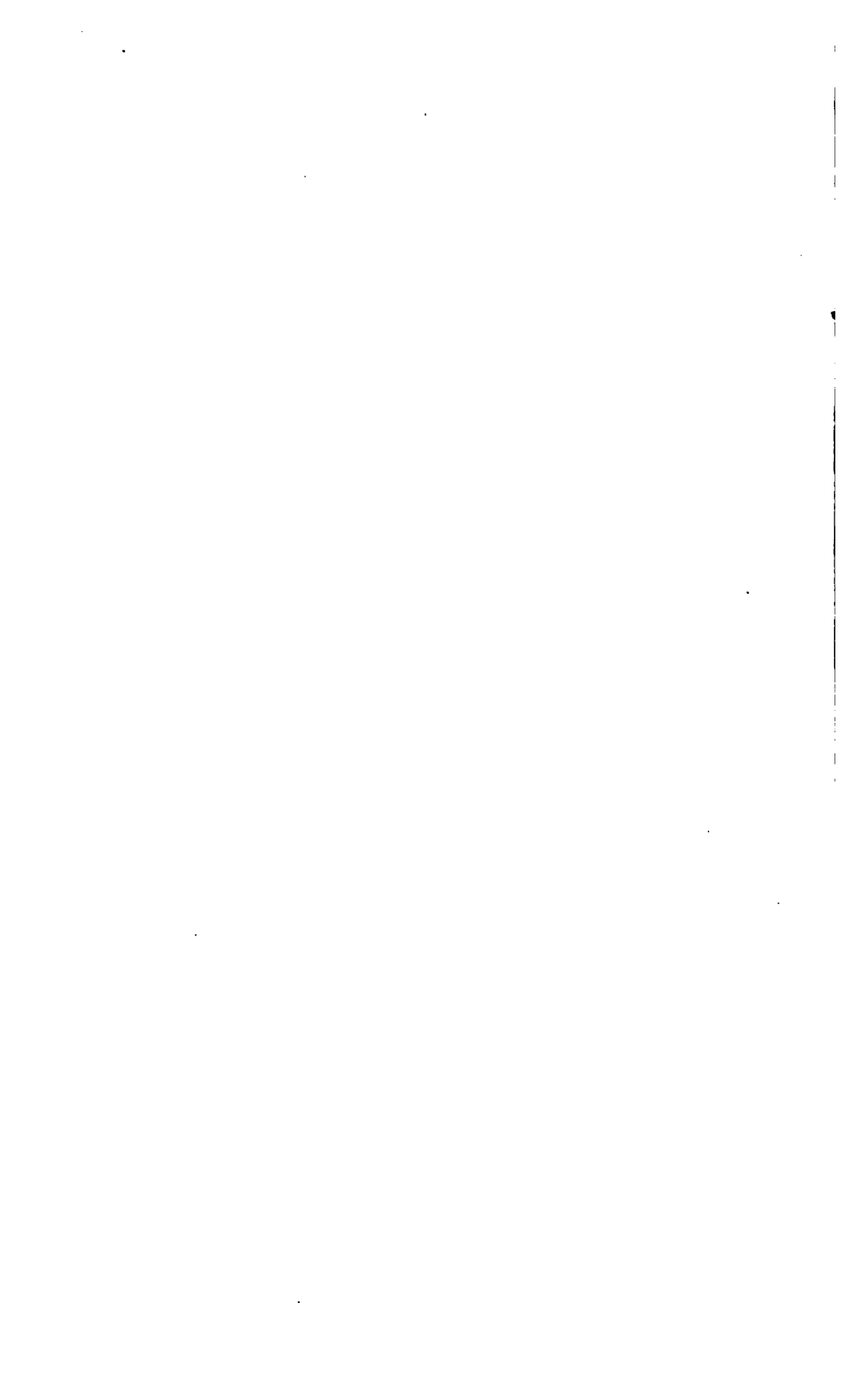
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TABLATION OF TENSILE SPECIMENS FROM 16" BY 18" NICKEL STEEL INGOT.
UNFORGED SPECIMENS AFTER HEAT TREATMENT OF THE STEEL.

STEMS OF SPECIMENS, ".564 DIAMETER, 3" LONG.

No. of test.	Treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of 100 of square area.	Elongation of inch sections.	Appearance of fracture.
7642	Heated straw color and cooled in dry sand. Subsequently heated to 500° ± F. in hot oil for a period of 4 hours.	Pounds. 34,000	Pounds. 66,400	Per cent. 21.7	Per cent. 36.4	" "	Dull silky, oblique.
7643	Heated blue and cooled in dry sand	35,000	66,000	21.3	36.4	.15, .33*, .16	Dull amorphous, varying in color.
7644	Heated red and cooled in dry sand	35,000	68,200	10.0	18.3	.08, .10, .12*	Granular, 70 per cent; smooth, dull-lead color, 30 per cent.
7645	Heated cherry and cooled in dry sand	33,000	64,000	10.3	21.4	.07, .07, .17	Dull amorphous, oblique. Flattened cavity, ".08 by ".20, with dark blue walls.
7646	Heated low yellow and cooled in dry sand	54,000	73,280	27.0	49.7	.19, .42*, .20	Silky, oblique, granular fracture; smooth, lustrous surface, with narrow band of lighter colored metal.
7647	Heated bright yellow and cooled in dry sand	45,000	71,600	25.3	39.2	.19, .38*, .18	Oblique, shearing fracture; smooth lustrous surface; seam of dark colored metal at circumference, ".25 by ".05.
7648	Heated white hot and cooled in dry sand	39,000	67,600	11.0	24.6	.18*, .07, .08	Silky, oblique; parted at the principal seam in the stem; surface of seam smooth and bright.
7649	Raised to scintillating heat and cooled in dry sand	39,000	64,000	7.0	21.4	.04, .02, .15	Fine granular; two small, bright, smooth spots.
7650	Heated white hot and quenched in oil	(a)	119,800	1.0	1.5	.02, .01, .00	Silky; interspersed with fine granulation.
7651	Heated white hot and quenched in brine	(a)	189,000	4.3	69.5	.03, .07*, .03	Silky; interspersed with fine granulation; small, smooth, lustrous spot, ".10 by ".05.
7652	Heated white hot and quenched in oil, and annealed at straw color	(a)	153,600	1.3	5.0	.01, .01, .02*	Silky and fine granulation interspersed.
7653	Heated white hot, quenched in oil, and annealed at blue heat.	(a)	126,400	1.0	5.0	.01, .02*, .00	Silky, oblique, 80 per cent; spot of smooth, lustrous metal, 20 per cent.
7654	Heated white hot, quenched in oil, and annealed at bright cherry.	51,000	63,920	7.3	24.6	.04, .05, .13	Silky, oblique; smooth, lustrous spots.
7655	Heated white hot, quenched in oil, and annealed at bright yellow.	45,000	63,600	8.3	21.4	.05, .07, .13	Fine silky.
7656	Heated white hot, quenched in oil, and annealed at white heat.	40,000	71,680	27.7	57.0	.17, .22, .44*	

* Defective specimens.

a Indefinite.

b Diameter of stem, ".565.

METAL FROM 16" BY 18" NICKEL STEEL INGOT.

FORGED SPECIMENS—SQUARE BARS DRAWN DOWN TO SQUARE BARS
AT DIFFERENT TEMPERATURES.

Original dimensions of specimens: 1".29 by 1".29 by 7".23 long.

No. 7819.

Heated to a low white (expansion, ".123 in 7".23), and drawn down
under the hammer at same temperature. Reduction, 39.8 per cent.

Cooled in the air.

Marks, 1.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0029	0.	
35,000	.0034	.....
40,000	.0040	0.	
45,000	.0045	.....	Elastic limit.
46,000	.0047	.....
47,000	.0355	.....
48,000	.0382	.....
49,000	.0418	.....
50,000	.0490	.0428	
51,000	.0518	.....
52,000	.0570	.....
53,000	.0685	.....
54,000	.0693	.....
56,000	.0800	.....
58,000	.0900	.....
60,000	.1080	.....
62,000	.1260	.....
64,000	.15	.....
68,000	.20	.....
70,000	.25	.....
72,000	.32	.....
74,000	.50	.....	Tensile strength.
0	.88	.....	-29.1 per cent.

Elongation of inch sections, ".42*", ".30", ".16.

Diameter at fracture, ".34; area, .0908 square inch.

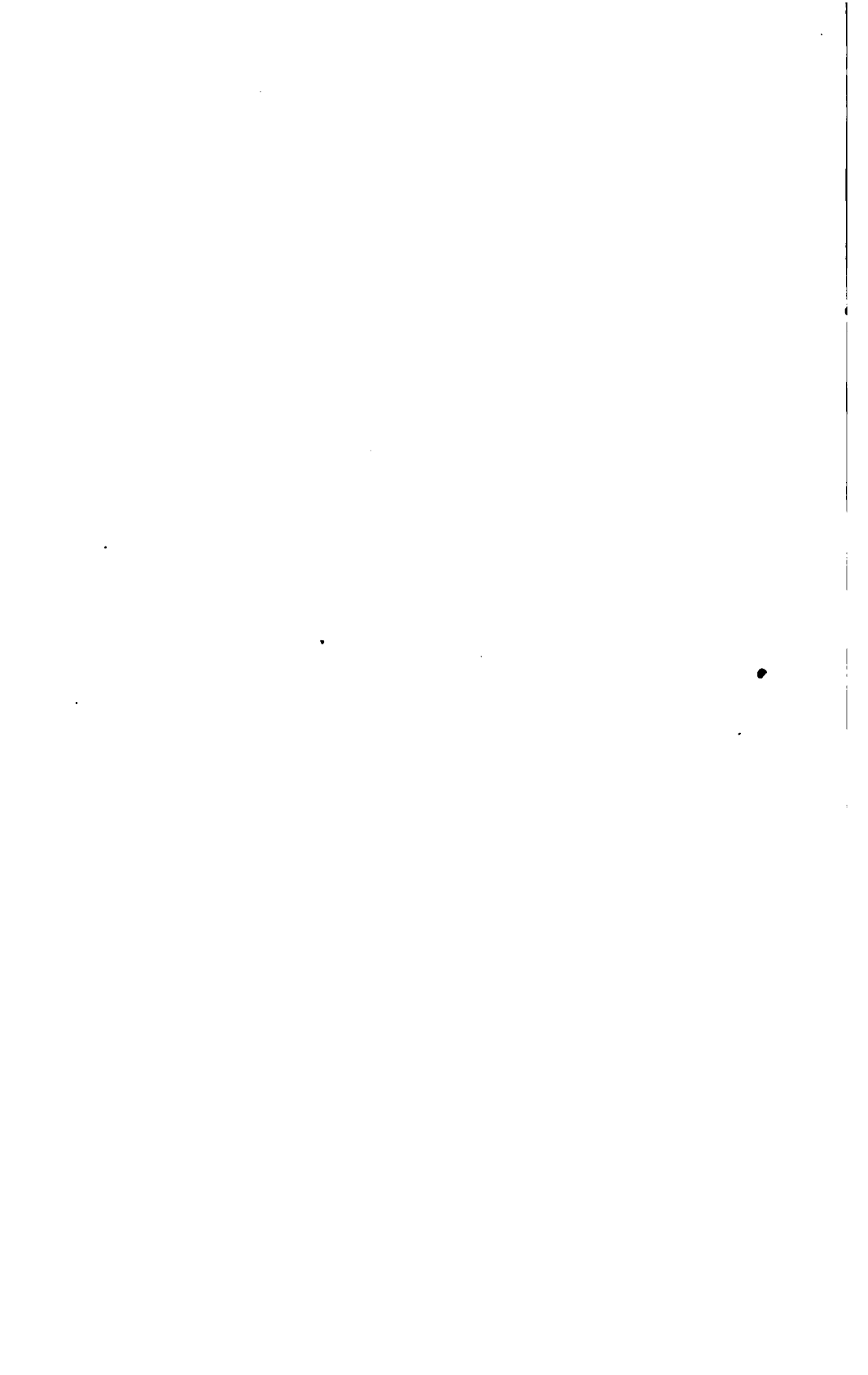
Contraction of area, 63.7 per cent.

Fractured 1".2 from the neck.

Appearance of fracture, fine silky.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 1, NO. 7819, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED LOW WHITE AND DRAWN DOWN UNDER THE HAMMER
AT SAME TEMPERATURE. COOLED IN AIR.





PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 2, NO. 7820, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BRIGHT YELLOW AND DRAWN DOWN UNDER THE HAMMER
AT SAME TEMPERATURE. COOLED IN DRY SAND.

No. 7820.

Heated to a bright yellow (expansion, ".104 in 7".23), and drawn down under the hammer at same temperature. Reduction, 39.8 per cent.

Cooled in dry sand.

Marks, 2.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0031	.....
40,000	.0041	0.	
45,000	.0047	.....
50,000	.0052	0.	
51,000	.0053	.....	Elastic limit. Load fell.
45,000	.0079	.....
46,000	.0093	.....
47,000	.0800	.....
48,000	.0515	.....
49,000	.0565	.....
50,000	.0620	.0560	
52,000	.0730	.....
54,000	.0685	.....
56,000	.1000	.....
58,000	.1140	.....
60,000	.1350	.....
62,000	.15	.....
64,000	.17	.....
66,000	.20	.....
68,000	.24	.....
70,000	.31	.....
71,920	.48	.....	Tensile strength.
0	1.00	.....	= 33.3 per cent.

Elongation of inch sections, ".21, ".57*, ".22.

Diameter at fracture, ".34; area, .0908 square inch.

Contraction of area, 63.7 per cent.

Fractured at middle of stem.

Appearance of fracture, fine silky, cup-shaped.

No. 7821.

Heated to a bright yellow (expansion, ".100 in 7".23), and drawn down under the hammer at same temperature. Reduction, 38 per cent.

Quenched in oil.

Marks, 3.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0037	.0005	
31,000	.0039	.....
32,000	.0040	.....
33,000	.0041	.....
34,000	.0043	.....
35,000	.0047	.0009	
36,000	.0049	.....
37,000	.0050	.....
38,000	.0051	.....
39,000	.0053	.....
40,000	.0055	.0012	
42,000	.0059	.....
44,000	.0062	.....
46,000	.0068	.....
48,000	.0071	.....
50,000	.0077	.0022	
52,000	.0082	.....
54,000	.0088	.....
56,000	.0093	.....
58,000	.0099	.....
60,000	.0107	.0040	
62,000	.0116	.....
64,000	.0122	.....
66,000	.0131	.....
68,000	.0142	.....
70,000	.0158	.0079	
72,000	.0170	.....
74,000	.0182	.....
76,000	.0202	.....
78,000	.0223	.....
80,000	.0258	.0165	
84,000	.03	.....
88,000	.04	.....
92,000	.05	.....
96,000	.06	.....
100,000	.09	.....
104,000	.12	.....
108,000	.20	.....
108,600	Tensile strength.
0	.48	16 per cent.

Load on bar at time of rupture, 21,000 pounds = 185,190 pounds per square inch on area at fracture.

Elongation of inch sections, ".04, ".15, ".29*.

Diameter at fracture, ".38; area, .1134 square inch

Contraction of area, 54.6 per cent.

Fractured 1".10 from the neck.

Appearance of fracture, fine silky, cup-shaped.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 3, NO. 7821, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BRIGHT YELLOW AND DRAWN DOWN UNDER THE
HAMMER AT SAME TEMPERATURE. QUENCHED IN OIL.







PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 4, NO. 7822, CROSS SECTION.

16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.

STEEL HEATED BRIGHT YELLOW AND DRAWN DOWN UNDER THE HAMMER

AT SAME TEMPERATURE. COOLED IN AIR.

No. 7822.

Heated to a bright yellow (expansion, ".096 in 7".23), and drawn down under the hammer at same temperature. Reduction, 34.9 per cent.

Cooled in the air.

Marks, 4.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	-----	Elastic limit. Load fell.
20,000	.0020	-----	
30,000	.0030	-----	
40,000	.0040	0.	
50,000	.0050	0.	
53,000	.0063	-----	
46,000	.0110	-----	
47,000	.0150	-----	
48,000	.0300	-----	
49,000	.0470	-----	
50,000	.0550	.0488	
52,000	.0620	-----	
54,000	.0735	-----	
56,000	.0860	-----	
58,000	.1000	-----	
60,000	.1195	.1112	
62,000	.13	-----	
64,000	.16	-----	
66,000	.18	-----	
68,000	.22	-----	
70,000	.27	-----	
72,000	.34	-----	
73,680	-----	-----	Tensile strength.
0	.84	-----	=28 per cent.

Load on bar at time of rupture, 13,400 pounds = 147,580 pounds per square inch on area at fracture.

Elongation of inch sections, ".15, ".50, ".19.

Diameter at fracture, ".34; area, .0908 square inch.

Contraction of area, 63.7 per cent.

Fractured 1".74 from the neck.

Appearance of fracture, silky, cup-shaped.

No. 7823.

Heated to a low yellow (expansion, ".081 in 7".23), and drawn down under the hammer at same temperature. Reduction, 34.9 per cent.

Cooled in dry sand.

Marks, 5.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	.....
40,000	.0040	0.	
50,000	.0051	0.	
54,000	.0054	.....
47,000	.0102	.....
48,000	.0108	.....
49,000	.0120	Elastic limit. Load fell.
50,000	.0628	.0468	
51,000	.0649	.....
52,000	.0680	.....
53,000	.0620	.....
54,000	.0680	.....
56,000	.0795	.....
58,000	.0930	.....
60,000	.1100	.1017	
62,000	.12	.....
64,000	.14	Tensile strength. =29.7 per cent.
66,000	.17	.....
68,000	.19	.....
70,000	.23	.....
72,000	.28	.....
74,000	.38	.....
74,400	.53	.....
0	.89	.....

Load on bar at time of rupture, 13,500 pounds=148,680 pounds per square inch on area at fracture.

Elongation of inch sections, ".17, ".51*, ".31.

Diameter at fracture, ".34; area, .0908 square inch.

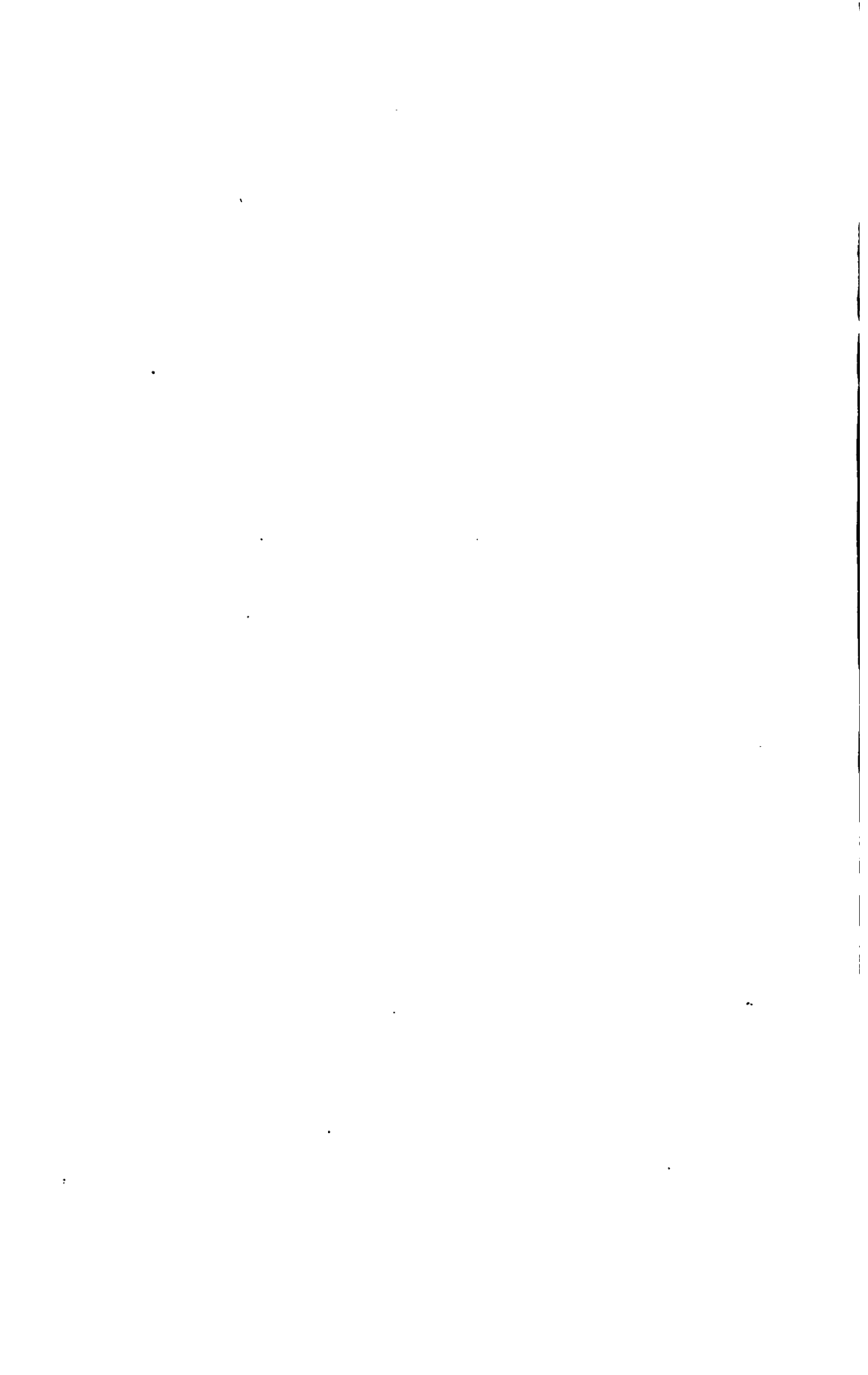
Contraction of area, 63.7 per cent.

Fractured 1".7 from the neck.

Appearance of fracture, silky, cup-shaped.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 5, NO. 7823, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED LOW YELLOW AND DRAWN DOWN UNDER THE HAMMER *
AT SAME TEMPERATURE. COOLED IN DRY SAND.





PHOTOGRAPH OF TENSILE SPECIMEN 6, NO. 7824, AFTER FRACTURE.

No. 7824.

Heated to a low yellow (expansion, ".083 in. 7".23), and drawn down under the hammer at same temperature. Reduction, 33.1 per cent.

Quenched in oil.

Marks, 6.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0031	.0001	
31,000	.0034	.....
32,000	.0038	.....
33,000	.0040	.....
34,000	.0041	.....
35,000	.0042	.0006	
36,000	.0044	.....
37,000	.0047	.....
38,000	.0049	.....
39,000	.0050	.....
40,000	.0052	.0010	
41,000	.0054	.....
42,000	.0057	.....
43,000	.0059	.....
44,000	.0061	.....
46,000	.0067	.....
48,000	.0071	.....
50,000	.0078	.0024	
52,000	.0082	.....
54,000	.0089	.....
56,000	.0097	.....
58,000	.0102	.....
60,000	.0113	.0050	
62,000	.0122	.....
64,000	.0133	.....
66,000	.0149	.....
68,000	.0167	.....
70,000	.0190	.0111	
72,000	.0205	.....
74,000	.0238	.....
76,000	.0272	.....
78,000	.0310	.....
80,000	.0370	.0274	
84,000	.04	.....
88,000	.05	.....
92,000	.07	.....
96,000	.10	.....
100,000	.13	.....
104,000	.21	.....
104,400	.33	.....	Tensile strength.
0	.57	.....	= 19 per cent.

Load on bar at time of rupture, 19,600 pounds = 182,330 pounds per square inch on area at fracture.

Elongation of inch sections, ".10, ".35*, ".12.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 57 per cent.

Fractured 1".5 from the neck.

Appearance of fracture, fine silky, cup-shaped. Oblique lines appeared on cylindrical surface during latter period of test.

No. 7825.

Heated to a low yellow (expansion, ".078 in 7".23), and drawn down under the hammer at same temperature. Reduction, 35.5 per cent.

Cooled in air.

Marks, 7.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0030	.....
40,000	.0040	0.	
50,000	.0050	0.	
53,000	.0055	.....
54,000	.0057	.....	Elastic limit. Load fell
50,000	.0080	.....
51,000	.0098	.....
52,000	.0675	.....
53,000	.0712	.....
54,000	.0770	.....
55,000	.0810	.....
56,000	.0880	.....
58,000	.1010	.....
60,000	.1175	.1092	
62,000	.13	.....
64,000	.15	.....
66,000	.17	.....
68,000	.20	.....
70,000	.25	.....
72,000	.31	.....
73,000	.46	.....	Tensile strength.
0	.94	.....	=31.3 per cent.

Load on bar at time of rupture, 15,500 pounds=136,680 pounds per square inch on area at fracture.

Elongation of inch sections, ".22, ".50*, ".22.

Diameter at fracture, ".38; area, .1134 square inch.

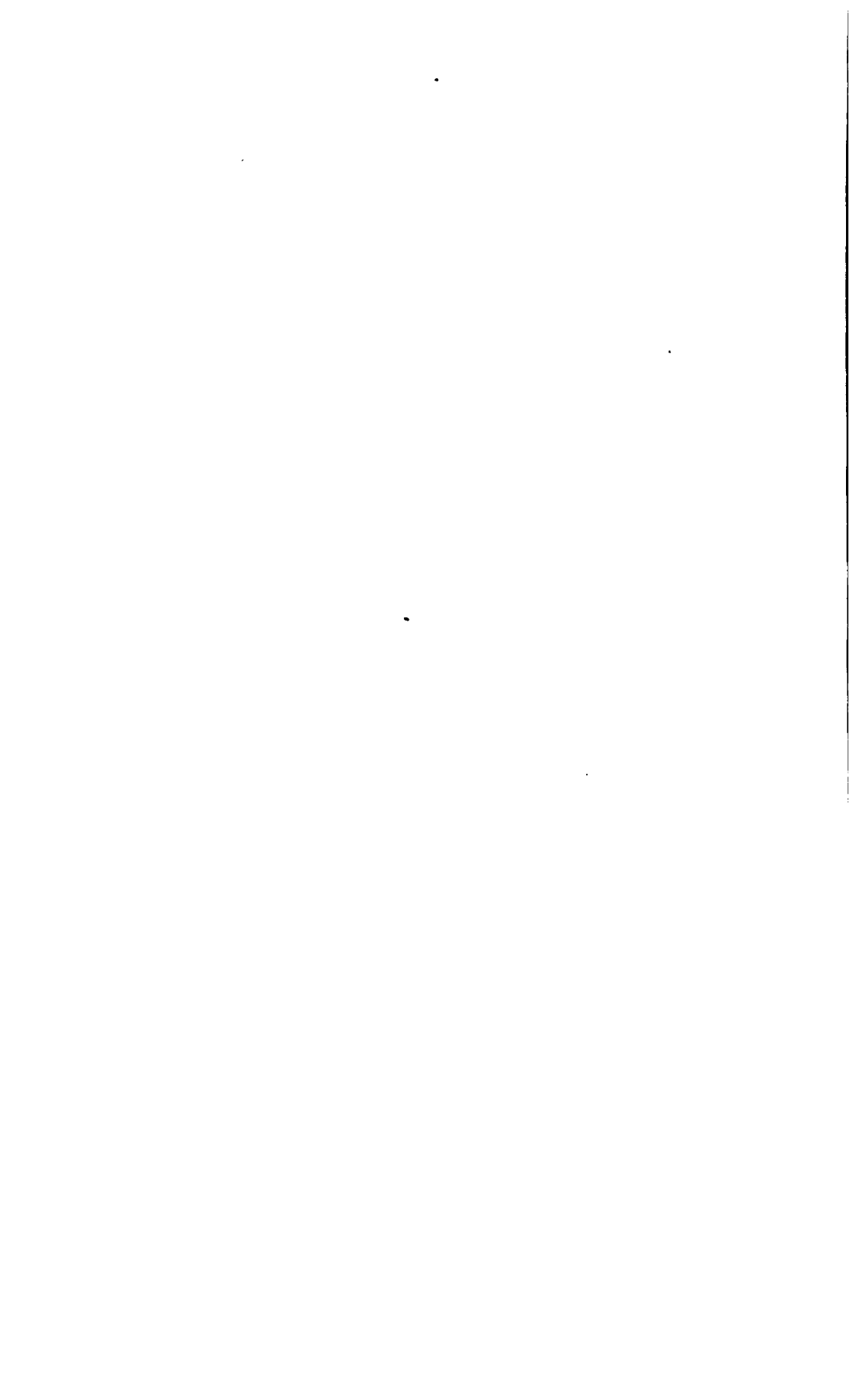
Contraction of area, 54.6 per cent.

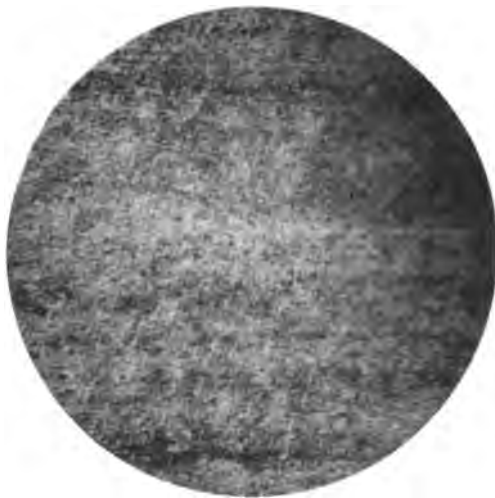
Fractured 1".83 from the neck.

Appearance of fracture, silky, irregular.



**PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 7, NO. 7825, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED LOW YELLOW AND DRAWN DOWN UNDER THE HAMMER
AT SAME TEMPERATURE. COOLED IN AIR.**





PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 8, NO. 7826, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED CHERRY AND DRAWN DOWN UNDER THE HAMMER
AT SAME TEMPERATURE. COOLED IN DRY SAND.

No. 7826.

Heated to a cherry (expansion, $.061$ in $7''.23$), and drawn down under the hammer at same temperature. Reduction, 30.7 per cent.

Cooled in dry sand.

Marks, 8.

Diameter $'' .564$.

Sectional area, $.25$ square inch.

Gauged length, $3''$.

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0004	0.		
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0031	.....	
40,000	.0043	0.		
50,000	.0054	0.		
54,000	.0057		Elastic limit. Load fell.
55,000	.0060	.....	
56,000	.0072	.....	
51,000	.0080	.....	
	.0084	.....	
52,000	.0772	.....	
53,000	.0798	.....	
54,000	.0850	.....	
55,000	.0990	.....	
58,000	.1160	.....	
60,000	.1300	.1219		
62,000	.14		
64,000	.17		
66,000	.20		
68,000	.24		
70,000	.29		
72,000	.39		
73,200	.54	Tensile strength. =23.3 per cent.	
0	.70	.....	

Elongation of inch sections, $'' .17$, $'' .23^*$, $'' .30$.

Diameter at fracture, $'' .45$; area, $.1590$ square inch.

Contraction of area, 36.4 per cent.

Fractured $'' .85$ from the neck.

Appearance of fracture, silky, oblique. Progressive fracture from a point in the circumference.

No. 7827.

Heated to a cherry (expansion, ".062 in 7".23), and drawn down under the hammer at same temperature. Reduction, 40.4 per cent.

Quenched in oil.

Marks, 9.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0031	0.	
40,000	.0049	.0007	
42,000	.0052	.....
44,000	.0057	.....
46,000	.0060	.....
48,000	.0068	.....
50,000	.0072	.0020	
52,000	.0080	.....
54,000	.0087	.....
56,000	.0095	.....
58,000	.0105	.....
60,000	.0117	.0050	
62,000	.0132	.....
64,000	.0155	.....
66,000	.0185	.....
68,000	.0212	.....
70,000	.0260	.0177	
72,000	.0285	.....
74,000	.0330	.....
76,000	.0397	.....
78,000	.0450	.....
80,000	.0520	.0421	
84,000	.06	.....
88,000	.08	.....
92,000	.10	.....
96,000	.15	.....
100,000	.24	.....
100,480	.....	.....	Tensile strength.
0	.58	.....	=17.7 per cent.

Load on bar at time of rupture, 19,200 pounds=169,310 pounds per square inch on area at fracture.

Elongation of inch sections, ".06, ".37*, ".10.

Diameter at fracture, ".38; area, .1134 square inch.

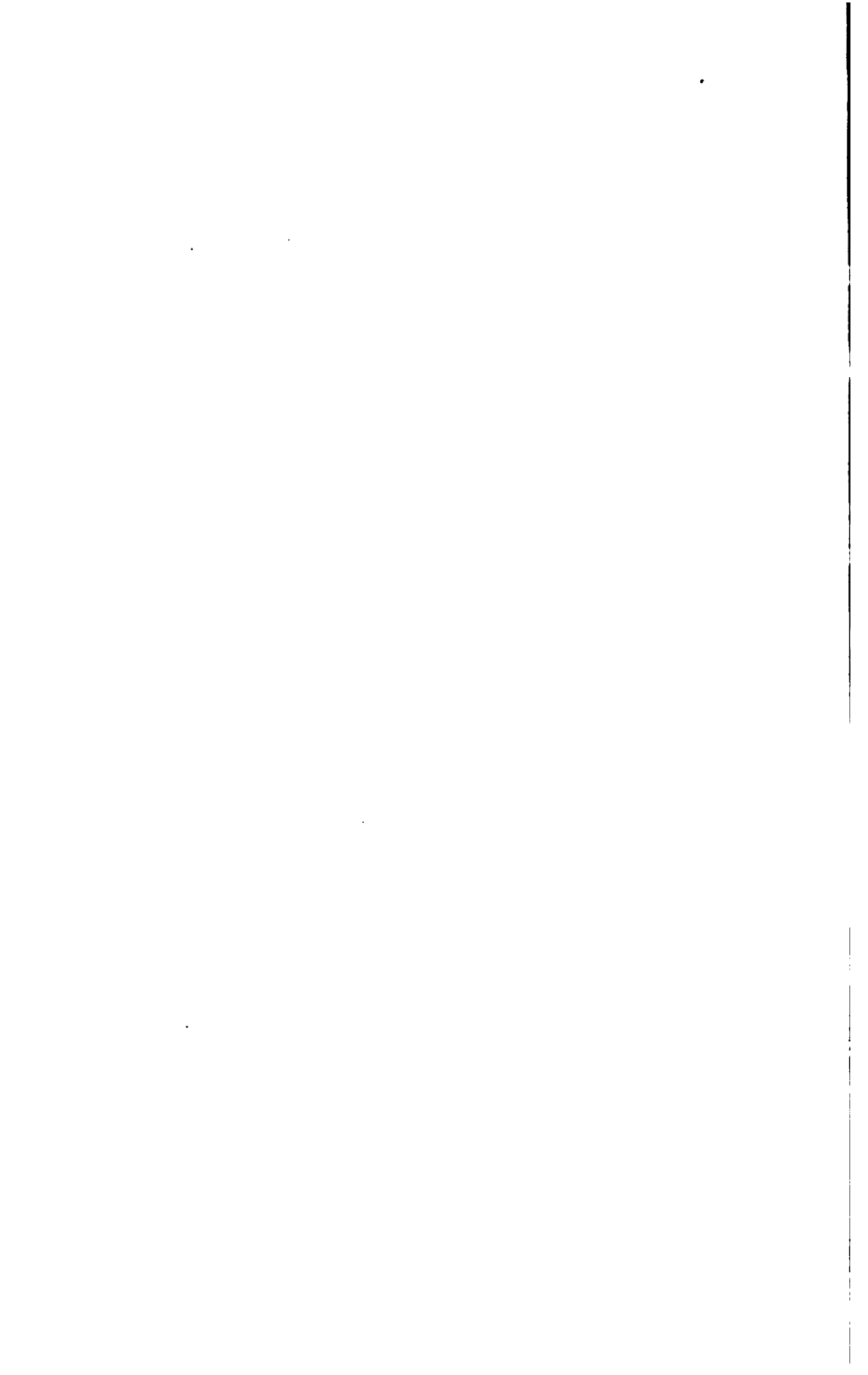
Contraction of area, 54.6 per cent.

Fractured 1".58 from the neck.

Appearance of fracture, fine silky, cup-shaped.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 9, NO. 7827, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED CHERRY AND DRAWN DOWN UNDER THE HAMMER
AT SAME TEMPERATURE. QUENCHED IN OIL.







PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 10, NO. 7828, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED CHERRY AND DRAWN DOWN UNDER THE HAMMER
AT SAME TEMPERATURE. COOLED IN AIR.

No. 7828.

Heated to a cherry (expansion, ".061 in 7".23), and drawn down under the hammer at same temperature. Reduction, 31.9 per cent.

Cooled in the air.

Marks, 10.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0021	.....
30,000	.0081	.....
40,000	.0042	0.	
50,000	.0062	0.	
58,000	.0060	.....	Elastic limit. Load fell
58,000	.0100	.....
54,000	.0558	.....
55,000	.0610	.....
56,000	.0908	.....
57,000	.0955	.....
58,000	.0995	.....
59,000	.1060	.....
60,000	.1190	.1115	
62,000	.12	.....
64,000	.15	.....
66,000	.17	.....
68,000	.20	.....
70,000	.25	.....
72,000	.30	.....
74,000	.40	.....
75,200	.....	.....	Tensile strength.
0	.89	.....	=29.7 per cent.

Load on bar at time of rupture, 13,700 pounds=150,880 pounds per square inch on area at fracture.

Elongation of inch sections, ".15, ".41*, ".33*.

Diameter at fracture, ".34; area, .0908 square inch.

Contraction of area, 63.7 per cent.

Fractured 1".32 from the neck.

Appearance of fracture, silky, cup-shaped.

No. 7829.

Heated to a blood red (expansion, in 7".23) and drawn down under the hammer at same temperature. Reduction, 37.3 per cent.

Cooled in dry sand.

Marks, 11.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0029	.....
40,000	.0039	0.	
50,000	.0050	0.	
53,000	.....	.....	Elastic limit; approximate.
55,000	.0058	.0005	
56,000	.0067	.....
57,000	.0073	.....
58,000	.0205	.....
59,000	.0380	.....
60,000	.0630	.0552	
61,000	.0641	.....
62,000	.0675	.....
64,000	.0860	.....
65,000	.1040	.....
68,000	.1220	.....
70,000	.1500	.1408	
72,000	.17	.....
74,000	.22	.....
75,000	.30	.....
76,800	.40	.....	Tensile strength.
0	.60	.....	=20 per cent.

Load on bar at time of rupture, 15,200 pounds=134,040 pounds per square inch on area at fracture.

Elongation of inch sections, ".09, ".14, ".37*.

Diameter at fracture, ".38; area, .1134 square inch.

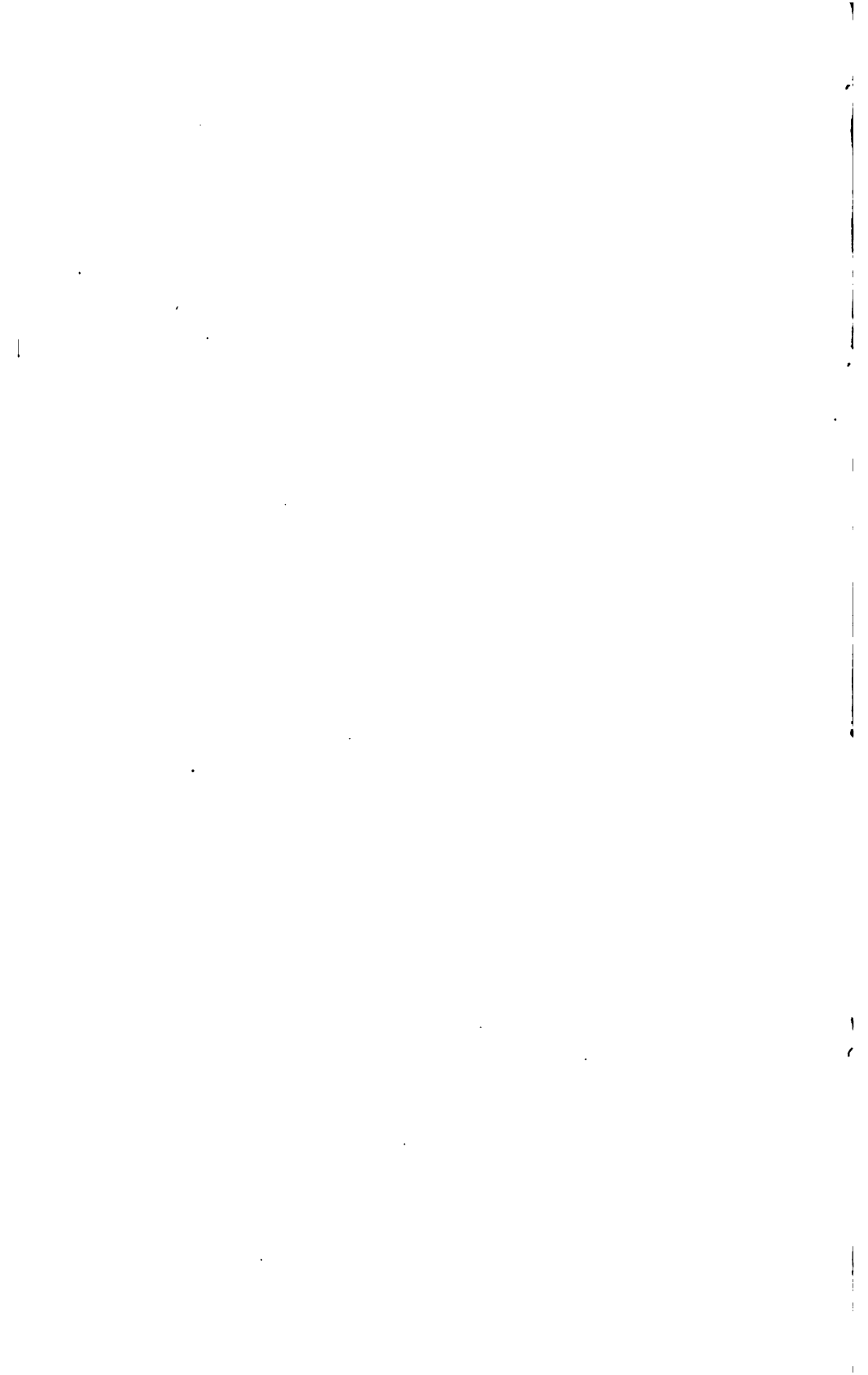
Contraction of area, 54.6 per cent.

Fractured ".95 from the neck.

Appearance of fracture, silky.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 11, NO. 7829, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BLOOD RED AND DRAWN DOWN UNDER THE HAMMER
AT SAME TEMPERATURE. COOLED IN DRY SAND.



No. 7830.

Heated to a blood red (expansion, ".043 in 7".23), and drawn down under the hammer at same temperature. Reduction, 34.3 per cent.

Quenched in oil.

Marks, 12.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	.....
35,000	.0035	.....
40,000	.0040	0.	
45,000	.0046	0.	
50,000	.0052	.0001	
51,000	.0054	.....
52,000	.0056	.....
53,000	.0058	.....
54,000	.0059	.....
55,000	.0060	.0008	
56,000	.0062	.....
57,000	.0064	.....
58,000	.0067	.....
59,000	.0069	.....
60,000	.0071	.0009	
61,000	.0074	.....
62,000	.0078	.....
63,000	.0081	.....
64,000	.0085	.....
65,000	.0090	.0022	
66,000	.0108	.....
67,000	.0438	.....
68,000	.0490	.....
69,000	.0512	.....
70,000	.0590	.0499	
71,000	.0600	.....
72,000	.0620	.....
73,000	.0618	.....
74,000	.0730	.....
75,000	.0790	.....
76,000	.0845	.....
78,000	.0980	.....
80,000	.1110	.1000	
84,000	.14	.....
88,000	.19	.....
92,000	.31	.....
92,800	.44	.....
0	.61	.....
			Tensile strength. --20.3 per cent.

Elongation of inch sections, ".32*", ".19", ".10.

Diameter at fracture, ".42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Fractured 1".15 from the neck.

Appearance of fracture, dull silky, oblique. Three lines of lighter-colored metal across the fractured surface.

No. 7831.

Heated to a blood red (expansion, ".045 in 7".23), and drawn down under the hammer at same temperature. Reduction, 36.1 per cent.

Cooled in the air.

Marks, 13.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads, per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009		
20,000	.0020		
30,000	.0030		
35,000	.0036		
40,000	.0040	0.	
45,000	.0046		
50,000	.0051	.0001	
55,000	.0057	.0001	
56,000	.0059		
57,000	.0060		
58,000	.0061		Elastic limit.
59,000	.0064		
60,000	.0069	.0007	Load fell.
61,000	.0074		
66,000	.0107		
67,000	.0115		
68,000	.0160		
69,000	.0372		
69,000	.0642	.0569	
61,000	.0760		
62,000	.0830		
63,000	.0868		
64,000	.1090		
65,000	.1155	.1068	
66,000	.12		
68,000	.15		
70,000	.18		
72,000	.21		
74,000	.25		
76,000	.32		
78,000	.50		Tensile strength.
0	.71		=21.7 per cent.

Load on bar at time of rupture, 14,200 pounds=118,930 pounds per square inch on area at fracture.

Elongation of inch section, ".14, ".27, ".33*.

Diameter at fracture, ".39; area, .1194 square inch.

Contraction of area, 52.2 per cent.

Fractured 1".25 from the neck.

Appearance of fracture, silky.

No. 7832.

Heated to a blue black (expansion, ".037 in 7".23), and drawn down under the hammer at same temperature. Reduction, 32.5 per cent.

Cooled in dry sand.

Marks, 14.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	0.	
35,000	.0035	.....
40,000	.0040	0.	
45,000	.0046	0.	
50,000	.0051	0.	
55,000	.0057	.....
60,000	.0061	0.	
65,000	.0066	.....
70,000	.0071	0.	
75,000	.0077	.....
79,000	.0082	.....
80,000	.0084	.0002	
81,000	.0086	.....
82,000	.0088	.....
83,000	.0090	.....
84,000	.0092	.....
85,000	.0094	.0007	
86,000	.0096	.....
87,000	.0099	.....
88,000	.0107	.....
89,000	.0110	.....
90,000	.0116	.0021	
91,000	.0121	.....
92,000	.0137	.....
93,000	.0150	.....
94,000	.0175	.....
95,000	.0215	.0112	
96,000	.0235	.....
97,000	.0276	.....
98,000	.0360	.....
99,000	.0430	.....
100,000	.0600	.0488	
100,400	Tensile strength.
0	.18	= 6 per cent.

Load on bar at time of rupture, 20,600 pounds=129,560 pounds per square inch on area at fracture.

Elongation of inch sections, ".00, ".18*, ".00.

Diameter at fracture, ".45; area, .1590 square inch.

Contraction of area, 36.4 per cent.

Fractured at middle of stem.

Appearance of fracture, dull silky, irregular surface, trace of granulation.

No. 7833.

Heated to a blue black (expansion, ".038 in 7".23), and drawn down under the hammer at same temperature. Reduction, 34.9 per cent.

Quenched in oil.

Marks, 15.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0004	0.		
10,000	.0010	-----		
20,000	.0020	-----		
30,000	.0030	-----		
40,000	.0040	0.		
50,000	.0050	0.		
60,000	.0060	0.		
70,000	.0070	0.		
80,000	.0081	0.		
82,000	.0084	-----		
84,000	.0089	-----		
86,000	.0095	-----		
88,000	.0100	-----		
90,000	.0115	.0020		
94,400	-----	-----		Crack opens in stem.
0	.02	-----		Tensile strength. =0.7 per cent.

Elongation of inch sections, ".01*", ".01", ".00.

Diameter at fracture, ".56; area, .2463 square inch.

Contraction of area, 1.5 per cent.

Fractured ".75 from the neck.

Appearance of fracture, granular, flaky.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 15, NO. 7833, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BLUE BLACK AND DRAWN DOWN UNDER THE HAMMER
AT SAME TEMPERATURE. QUENCHED IN OIL.

No. 7834.

Heated to a blue black (expansion, ".040 in 7".23), and drawn down under the hammer at same temperature. Reduction, 31.3 per cent.

Cooled in the air.

Marks, 16.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	.....
40,000	.0040	0.	
50,000	.0050	.....
60,000	.0060	0.	
70,000	.0070	.....
80,000	.0082	.0001	
82,000	.0086	.....
84,000	.0090	.....
85,000	.0098	.....
88,000	.0107	.....
90,000	.0121	.0030	
92,000	.0144	.....
94,000	.0210	.....
96,000	.0370	.....
98,000	.0590	.....
100,000	.0885	.0811	
101,200	.10	} Tensile strength. = 9 per cent.
	.17	.....
0	.27	.....

Load on bar at time of rupture, 21,800 pounds = 125,650 pounds per square inch on area at fracture.

Elongation of inch sections, ".04, ".06, ".17*.

Diameter at fracture, ".47; area, .1735 square inch.

Contraction of area, 30.6 per cent.

Fracture, ".95 from the neck.

Appearance of fracture, silky.

No. 7835.

Heated to a deep straw (expansion, ".026 in 7".23), and drawn down under the hammer at same temperature. Reduction, 26.5 per cent.

Cooled in the air.

Marks, 17.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	.....
40,000	.0040	0.	
50,000	.0050	.....
60,000	.0060	0.	
70,000	.0070	.....
80,000	.0080	0.	
90,000	.0092	.0001	
92,000	.0097	.....
94,000	.0101	.....
96,000	.0106	.....
98,000	.0111	.....
100,000	.0120	.0017	
102,000	.0128	.....
104,000	.0140	.....
106,000	Tensile strength. =0.7 per cent.
0	.02	.....

Elongation of inch sections, ".00, ".02*, ".00.

Diameter at fracture, ".56; area, .2463 square inch.

Contraction of area, 1.5 per cent.

Fractured 1".1 from the neck.

Appearance of fracture, granular, flaky.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN 17, NO. 7835, CROSS SECTION.
16-INCH BY 18-INCH NICKEL STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED DEEP STRAW AND DRAWN DOWN UNDER THE HAMMER
AT SAME TEMPERATURE. COOLED IN AIR.

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No. 7836.

Heated to a low white (expansion, ".115 in 7".23), and drawn down under the hammer at same temperature. Reduction, 41.6 per cent.

Quenched in oil.

Marks, 18.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0035	.0003	
32,000	.0038	.....
34,000	.0040	.....
36,000	.0043	.....
38,000	.0048	.....
40,000	.0051	.0010	
42,000	.0055	.....
44,000	.0060	.....
46,000	.0065	.....
48,000	.0070	.....
50,000	.0074	.0021	
52,000	.0080	.....
54,000	.0086	.....
56,000	.0092	.....
58,000	.0099	.....
60,000	.0107	.0041	
62,000	.0113	.....
64,000	.0121	.....
66,000	.0133	.....
68,000	.0145	.....
70,000	.0160	.0083	
72,000	.0174	.....
74,000	.0199	.....
76,000	.0225	.....
78,000	.0251	.....
80,000	.0290	.0198	
82,000	.0320	.....
84,000	.0370	.....
86,000	.0430	.....
88,000	.0480	.....
90,000	.0569	.0459	
94,000	.07	.....
98,000	.09	.....
100,000	.11	.....
102,000	.13	.....
104,000	.17	.....
104,800	.22	.....
0	.44	.....
			Tensile strength. = 14.7 per cent.

Load on bar at time of rupture, 20,400 pounds = 179,890 pounds per square inch on area at fracture.

Elongation of inch sections, ".04, ".33*, ".07.

Diameter at fracture, ".38; area, .1134 square inch.

Contraction of area, 54.6 per cent.

Fractured 1".55 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7837.

Heated to a low white (expansion, ".113 in 7".23), and drawn down under the hammer at same temperature. Reduction, 40.4 per cent.

Cooled in dry sand.

Marks, 19.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	0.	
40,000	.0040	0.	
50,000	.0050	0.	
52,000	.0052	.....	Elastic limit. Load fell.
45,000	.0099	.....
46,000	.0106	.....
47,000	.0370	.....
48,000	.0500	.....
49,000	.0550	.....
50,000	.0609	.0648	
51,000	.0632	.....
52,000	.0700	.....
53,000	.0750	.....
54,000	.0833	.....
56,000	.0975	.....
58,000	.1120	.....
60,000	.1285	.1203	
62,000	.15	.....
64,000	.17	.....
66,000	.20	.....
68,000	.25	.....
69,000	.28	.....
70,000	.32	.....
72,000	.45	.....
73,120	.63	.....	Tensile strength.
0	.96	.....	= 32 per cent.

Load on bar at time of rupture, 12,800 pounds = 140,970 pounds per square inch on area at fracture.

Elongation of inch sections, ".17, ".31, ".48*.

Diameter at fracture, ".34; area, .0908 square inch.

Contraction of area, 63.7 per cent.

Fractured 1".17 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7838.

Heated to a low white (expansion, ".112 in 7".23), and drawn down under the hammer at same temperature. Reduction, 44.6 per cent.

Quenched in water.

Marks, 20.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0030	0.	
35,000	.0036	.....
40,000	.0041	0.	
45,000	.0047	.....
50,000	.0053	.0001	
55,000	.0059	.....
60,000	.0067	.0004	
65,000	.0073	.....
70,000	.0081	.0008	
75,000	.0089	.....
80,000	.0097	.0011	
85,000	.0104	.....
90,000	.0112	.0018	
95,000	.0122	.....
100,000	.0134	.0028	
105,000	.0148	.....
110,000	.0159	.0039	
115,000	.0176	.....
120,000	.0190	.0157	
130,000	.08	.....
140,000	.04	.....
150,000	.05	.....
160,000	.06	.....
170,000	.11	.....
170,960	Tensile strength.
0	.15	-5 per cent.

Load on bar at time of rupture, 41,500 pounds=211,300 pounds per square inch on area at fracture.

Elongation of inch sections, ".02, ".03, ".10*.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Fractured, ".45 from the neck.

Appearance of fracture, silky, cup-shaped, trace of granulation.

CARBON AND NICKEL STEEL INGOTS

No. 7839.

Heated to a yellow (expansion, ".094 in 7".23), and drawn down under the hammer at same temperature. Reduction, 39.8 per cent.

Quenched in water.

Marks, 21.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0030	.....
40,000	.0041	.0001	
45,000	.0047	.....
50,000	.0055	.0003	
55,000	.0061	.....
60,000	.0069	.0006	
65,000	.0076	.....
70,000	.0084	.0010	
75,000	.0091	.....
80,000	.0100	.0017	
85,000	.0109	.....
90,000	.0120	.0023	
95,000	.0130	.....
100,000	.0142	.0034	
105,000	.0155	.....
110,000	.0170	.0050	
115,000	.0184	.....
120,000	.0203	.0070	
130,000	.03	.....
140,000	.04	.....
150,000	.06	.....
160,000	.07	.....
162,880	Tensile strength.
0	.14	= 4.7 per cent.

Load on bar at time of rupture, 38,000 pounds=193,480 pounds per square inch on area at fracture.

Elongation of inch sections, ".01, ".02, ".11*.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Fractured, ".2 from the neck.

Appearance of fracture, silky, cup-shaped.

No. 7840.

Heated to a low yellow (expansion, ".087 in 7".23), and drawn down under the hammer at same temperature. Reduction, 41.6 per cent.

Quenched in water.

Marks, 22.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0030	0.	
40,000	.0043	.0002	
45,000	.0049	.0004	
50,000	.0057	.0007	
55,000	.0064	.....
60,000	.0071	.0011	
65,000	.0080	.....
70,000	.0090	.0018	
75,000	.0098	.....
80,000	.0110	.0028	
85,000	.0119	.....
90,000	.0132	.0039	
95,000	.0145	.....
100,000	.0162	.0057	
105,000	.0178	.....
110,000	.0200	.0082	
115,000	.0223	.....
120,000	.0258	.0126	
130,000	.04	.....
140,000	.06	.....
150,000	.09	.....
154,240	Tensile strength.
0	.22	=7.3 per cent.

Load on bar at time of rupture, 36,200 pounds=191,940 pounds per square inch on area at fracture.

Elongation of inch sections, ".02, ".17*, ".03.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Fractured 1".37 from the neck.

Appearance of fracture, silky, oblique. Oblique lines on cylindrical surface in vicinity of fracture.

CARBON AND NICKEL STEEL INGOTS.

No. 7841.

Heated to a cherry (expansion, ".059 in 7".23), and drawn down under the hammer at same temperature. Reduction, 39.2 per cent.

Quenched in water.

Marks, 23.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0029	0.	
40,000	.0040	0.	
45,000	.0046	.....
48,000	.0049	.....	Elastic limit; approximate.
49,000	.0053	.....
50,000	.0058	.0008	
51,000	.0060	.....
52,000	.0062	.....
53,000	.0064	.....
54,000	.0067	.....
55,000	.0069	.0011	
56,000	.0071	.....
57,000	.0073	.....
58,000	.0075	.....
59,000	.0077	.....
60,000	.0080	.0018	
65,000	.0090	.....
70,000	.0105	.0031	
75,000	.0120	.....
80,000	.0138	.0054	
85,000	.0160	.....
90,000	.0190	.0091	
95,000	.0219	.....
100,000	.0262	.0150	
105,000	.0312	.....
110,000	.0391	.0260	
115,000	.0461	.....
120,000	.0600	.0453	
126,200	.....	.....	Tensile strength.
0	.10	.....	= 3.3 per cent.

Elongation of inch sections, ".05*", ".02, ".03.

Diameter at fracture, ".55; area, .2376 square inch.

Contraction of area, 5 per cent.

Fractured ".4 from the neck.

Appearance of fracture, silky, oblique, irregular. Fractured under the maximum load. Slight snapping sounds immediately preceded rupture.

No. 7842.

Heated to a blood red (expansion, ".037 in 7".23), and drawn down under the hammer at same temperature. Reduction, 37.3 per cent.

Quenched in water.

Marks, 24.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	0.	
40,000	.0041	0.	
45,000	.0046	0.	
50,000	.0053	.0002	
51,000	.0056	.....
52,000	.0059	.....
53,000	.0061	.....
54,000	.0064	.....
55,000	.0068	.0009	
56,000	.0072	.....
57,000	.0077	.....
58,000	.0085	.....
59,000	.0097	.....
60,000	.0137	.0070	Rested 55 minutes under initial load.
61,000	.0159	.....
62,000	.0228	.....
63,000	.0280	.....
64,000	.0390	.....
65,000	.0410	.0332	
66,000	.0430	.....
67,000	.0470	.....
68,000	.0600	.....
69,000	.0643	.....
70,000	.0710	.0620	Rested 10 minutes under initial load.
71,000	.0738	.....
72,000	.0810	.....
73,000	.0900	.0811	Rested 6 minutes.
74,000	.1010	.....
76,000	.1264	.....
78,000	.1490	.....
80,000	.1875	.1760	
82,000	.25	.....	Tensile strength.
0	.53	.....	- 17.7 per cent.

Load on bar at time of rupture, 18,000 pounds=136,360 pounds per square inch on area at fracture.

Elongation of inch sections, ".04, ".17, ".32*.

Diameter at fracture, ".41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Fractured 1".03 from the neck.

Appearance of fracture, silky, oblique.

No. 7841.

Heated to a cherry (expansion, ".059 in 7".23), and drawn down under the hammer at same temperature. Reduction, 39.2 per cent.

Quenched in water.

Marks, 23.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	-----	
20,000	.0019	-----	
30,000	.0029	0.	
40,000	.0040	0.	
45,000	.0046	-----	
48,000	.0049	-----	Elastic limit; approximate.
49,000	.0053	-----	
50,000	.0058	.0008	
51,000	.0060	-----	
52,000	.0062	-----	
53,000	.0064	-----	
54,000	.0067	-----	
55,000	.0069	.0011	
56,000	.0071	-----	
57,000	.0073	-----	
58,000	.0075	-----	
59,000	.0077	-----	
60,000	.0080	.0018	
65,000	.0090	-----	
70,000	.0105	.0031	
75,000	.0120	-----	
80,000	.0138	.0054	
85,000	.0160	-----	
90,000	.0190	.0091	
95,000	.0219	-----	
100,000	.0262	.0150	
105,000	.0312	-----	
110,000	.0391	.0260	
115,000	.0461	-----	
120,000	.0600	.0453	
126,200	-----	-----	Tensile strength.
0	.10	-----	= 3.3 per cent.

Elongation of inch sections, ".05*", ".02, ".03.

Diameter at fracture, ".55; area, .2376 square inch.

Contraction of area, 5 per cent.

Fractured ".4 from the neck.

Appearance of fracture, silky, oblique, irregular. Fractured under the maximum load. Slight snapping sounds immediately preceded rupture.

No. 7842.

Heated to a blood red (expansion, ".037 in 7".23), and drawn down under the hammer at same temperature. Reduction, 37.3 per cent.

Quenched in water.

Marks, 24.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	-----	
20,000	.0020	-----	
30,000	.0030	0.	
40,000	.0041	0.	
45,000	.0046	0.	
50,000	.0053	.0002	
51,000	.0056	-----	
52,000	.0059	-----	
53,000	.0061	-----	
54,000	.0064	-----	
55,000	.0068	.0009	
56,000	.0072	-----	
57,000	.0077	-----	
58,000	.0085	-----	
59,000	.0097	-----	
60,000	.0137	.0070	Rested 55 minutes under initial load.
61,000	.0159	-----	
62,000	.0228	-----	
63,000	.0280	-----	
64,000	.0390	-----	
65,000	.0410	.0332	
66,000	.0430	-----	
67,000	.0470	-----	
68,000	.0600	-----	
69,000	.0643	-----	
70,000	.0710	.0620	Rested 10 minutes under initial load.
71,000	.0738	-----	
72,000	.0810	-----	
73,000	.0900	.0811	Rested 6 minutes.
74,000	.1010	-----	
76,000	.1264	-----	
78,000	.1490	-----	
80,000	.1875	.1760	
82,000	.25	-----	Tensile strength.
82,800	-----	-----	= 17.7 per cent.
0	.53	-----	

Load on bar at time of rupture, 18,000 pounds=136,360 pounds per square inch on area at fracture.

Elongation of inch sections, ".04, ".17, ".32*.

Diameter at fracture, ".41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Fractured 1".03 from the neck.

Appearance of fracture, silky, oblique.

No. 7843.

Heated to a yellow (expansion, ".085 in 7".23), and drawn down under the hammer at same temperature. Reduction, 42.8 per cent.

Quenched in water.

Annealed at cherry, cooling in sand.

Marks, 25.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0031	0.	
40,000	.0041	0.	
50,000	.0052	0.	
53,000	.0055	.....	Elastic limit. Load fell.
48,000	.0078	.....
49,000	.0520	.....
50,000	.0672	.....
51,000	.0742	.....
52,000	.0827	.....
53,000	.0860	.....
54,000	.0912	.....
56,000	.1035	.....
58,000	.1192	.....
60,000	.1400	.1320	
62,000	.17	.....
64,000	.19	.....
66,000	.23	.....
68,000	.28	.....
70,000	.35	.....
72,000	.47	.....
73,280	.....	.....	Tensile strength.
0	1.03	.....	34.3 per cent.

Load on bar at time of rupture, 12,600 pounds=130,980 pounds per square inch on area at fracture.

Elongation of inch sections, ".25, ".54*, ".24.

Diameter at fracture, ".35; area, .0962 square inch.

Contraction of area, 61.5 per cent.

Fractured 1".7 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7844.

Heated to a yellow (expansion, ".090 in 7".23), and drawn down under the hammer at same temperature. Reduction, 42.8 per cent.

Quenched in water.

Annealed at bright red, cooling in sand.

Marks, 26.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0009	.....	
20,000	.0020	.....	
30,000	.0030	0.		
35,000	.0036	.....	
40,000	.0041	0.		
45,000	.0046	0.		
50,000	.0051	0.		
53,000	.0054		Elastic limit.
54,000	.0070		Load fell.
48,000	.0100		
49,000	.0110		
50,000	.0149		
51,000	.0760		
52,000	.0800	.....	
52,000	.0855	.....	
54,000	.0965	.....	
56,000	.1120	.....	
58,000	.1300	.....	
60,000	.1500	.1423		
62,000	.18	.....	
64,000	.20	.....	
66,000	.24	.....	
68,000	.29	.....	
70,000	.36	.....	
72,000	.58	.....	
72,400	.75	.....	Tensile strength.
0	1.00	.....	.33.3 per cent.

Load on bar at time of rupture, 12,700 pounds=139,870 pounds per square inch on area at fracture.

Elongation of inch sections, ".44", ".35", ".21.

Diameter at fracture, ".34; area, .0908 square inch.

Contraction of area, 63.7 per cent.

Fractured 1".25 from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7845.

Heated to a yellow (expansion, ".091 in 7".23), and drawn down under the hammer at same temperature. Reduction, 45.8 per cent.

Quenched in water.

Annealed at yellow, cooling in sand.

Marks, 27.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
20,000	.0021	0.	
30,000	.0031	0.	
40,000	.0041	0.	
50,000	.0052	0.	
51,000	.0054		Elastic limit. Load fell.
46,000	.0064		
47,000	.0100		
48,000	.0511		
49,000	.0630		
50,000	.0690		
51,000	.0750		
52,000	.0830		
54,000	.0922		
56,000	.1085		
58,000	.1250		
60,000	.1485	.1408	
62,000	.17		
64,000	.20		
66,000	.24		
68,000	.30		
70,000	.38		
71,800	.59		Tensile strength.
0	.91		=30.3 per cent.

Load on bar at time of rupture, 13,200 pounds=137,210 pounds per square inch on area at fracture.

Elongation of inch sections, ".19, ".51*, ".21.

Diameter at fracture, ".35; area, .0962 square inch.

Contraction of area, 61.5 per cent.

Fractured 1".78 from the neck.

Appearance of fracture, fine silky, cup-shaped.

TABLATION OF TENSION SPECIMENS FROM 16" BY 16" NICKEL STEEL INGOT.
 FORGED SPECIMENS—SQUARE BARS DRAWN DOWN TO SQUARE BARS AT DIFFERENT TEMPERATURES.

STEMS OF SPECIMENS, ".564 DIAMETER, 3" LONG.

No. of test.	Treatment.	Reduction.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3".	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
7819	Heated low white and drawn down under the hammer at same. Cooled in air.	Per cent. 36.8	Pounds. 46,000	Pounds. 74,000	Per cent. 29.1	Per cent. 63.7	" "	Fine silky.
7820	Heated bright yellow and drawn down under the hammer at same. Cooled in dry sand.	36.8	51,000	71,920	33.3	63.7	.42%, .30, .16	Fine silky, cup-shaped.
7821	Heated bright yellow and drawn down under the hammer at same. Quenched in oil.	38.0	(a)	108,000	16.0	54.6	.04, .15, .29*	Do.
7822	Heated bright yellow and drawn down under the hammer at same. Cooled in air.	34.9	58,000	73,680	28.0	63.7	.15, .50%, .19	Do.
7823	Heated low yellow and drawn down under the hammer at same. Cooled in dry sand.	34.9	54,000	74,400	29.7	63.7	.17, .51%, .31	Silky, cup-shaped.
7824	Heated low yellow and drawn down under the hammer at same. Quenched in oil.	33.1	(a)	104,400	19.0	57.0	.10, .35%, .12	Fine silky, cup-shaped. Oblique lines appeared on cylindrical surface during latter period of test.
7825	Heated low yellow and drawn down under the hammer at same. Cooled in air.	35.5	54,000	73,600	31.3	54.6	.22, .50%, .22	Silky, irregular.
7826	Heated cherry and drawn down under the hammer at same. Cooled in dry sand.	30.7	54,000	73,200	23.3	36.4	.17, .28, .30*	Silky, oblique. Progressive fracture from a point in the circumference.
7827	Heated cherry and drawn down under the hammer at same. Quenched in oil.	40.4	(a)	100,480	17.7	54.6	.06, .37%, .10	Fine silky, cup-shaped.
7828	Heated cherry and drawn down under the hammer at same. Cooled in air.	31.9	58,000	75,200	29.7	63.7	.15, .41%, .33*	Silky, cup-shaped.
7829	Heated blood red and drawn down under the hammer at same. Cooled in dry sand.	37.3	53,000	76,800	20.0	54.6	.09, .14, .37*	Silky.
7830	Heated blood red and drawn down under the hammer at same. Quenched in oil.	34.3	(a)	92,800	20.3	44.6	.32%, .19, .10	Dull silky, oblique. Three lines of lighter-colored metal across the fractured surface.
7831	Heated blood red and drawn down under the hammer at same. Cooled in air.	36.1	58,000	78,000	24.7	52.2	.14, .27, .33*	Silky.
7832	Heated blue black and drawn down under the hammer at same. Cooled in dry sand.	32.5	(a)	100,400	6.0	36.4	.00, .18%, .00	Dull silky, irregular surface, trace of granulation.
7833	Heated blue black and drawn down under the hammer at same. Quenched in oil.	34.9	(a)	94,400	0.7	1.5	.01%, .01, .00	Granular, flaky.

b Approximate.

c Indefinite.

TABULATION OF TENSION SPECIMENS FROM 16" BY 16" NICKEL STEEL STEEL INGOT—Continued.
 FORGED SPECIMENS—SQUARE BARS DRAWN DOWN TO SQUARE BARS AT DIFFERENT TEMPERATURES—Continued.

STEMS OF SPECIMENS, $\frac{3}{4}$ " DIAMETER, 3" LONG—Continued.

No. of test.	Treatment.	Reduction.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3".	Contraction of area.	Elongation of inch section.	Appearance of fracture.
		Per cent.	Pounds. (a)	Pounds.	Per cent.	Per cent.	" "	
7834	Heated blue black and drawn down under the hammer at same. Cooled in air.	31.3		101,200	9.0	30.6	" "	Silky.
7835	Heated deep straw and drawn down under the hammer at same. Cooled in air.	26.5	(a)	106,000	0.7	1.6	.04, .06, .17*	Granular, flaky.
7836	Heated low white and drawn down under the hammer at same. Quenched in oil.	41.6	(a)	104,800	14.7	54.6	.04, .02*, .00	Fine silky, cup-shaped.
7837	Heated low white and drawn down under the hammer at same. Cooled in dry sand.	40.4	52,000	73,120	32.0	63.7	.17, .31, .48*	Do.
7838	Heated low white and drawn down under the hammer at same. Quenched in water.	44.6	(a)	170,960	5.0	21.4	.02, .03, .10*	Silky, cup-shaped, trace of granulation.
7839	Heated yellow and drawn down under the hammer at same. Quenched in water.	39.8	(a)	162,880	4.7	21.4	.01, .02, .11*	Silky, cup-shaped.
7840	Heated low yellow and drawn down under the hammer at same. Quenched in water.	41.6	(a)	154,240	7.8	24.6	.02, .17*, .03	Silky, oblique. Oblique lines on cylindrical surface in vicinity of fracture.
7841	Heated cherry and drawn down under the hammer at same. Quenched in water.	39.2	648,000	126,200	3.3	5.0	.05*, .02, .03	Silky, oblique, irregular. Fractured under the maximum load.
7842	Heated blood red and drawn down under the hammer at same. Quenched in water.	37.3	(a)	82,800	17.7	47.2	.04, .17, .32*	Silky, oblique.
7843	Heated yellow and drawn down under the hammer at same. Quenched in water. Annealed at cherry, cooling in sand.	42.8	53,000	73,280	34.8	61.5	.25, .54*, .24	Fine silky, cup-shaped.
7844	Heated yellow and drawn down under the hammer at same. Quenched in water. Annealed at bright red, cooling in sand.	42.8	53,000	72,400	38.3	68.7	.44*, .85, .21	Do.
7845	Heated yellow and drawn down under the hammer at same. Quenched in water. Annealed at yellow, cooling in sand.	45.8	51,000	71,800	30.3	61.5	.19, .51*, .21	Do.

^b Approximate.

^a Indefinite.

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ating by different methods

No. 7819

No. 7837

me, quenched in water.

" " oil.

cooled " air.

" " sand.

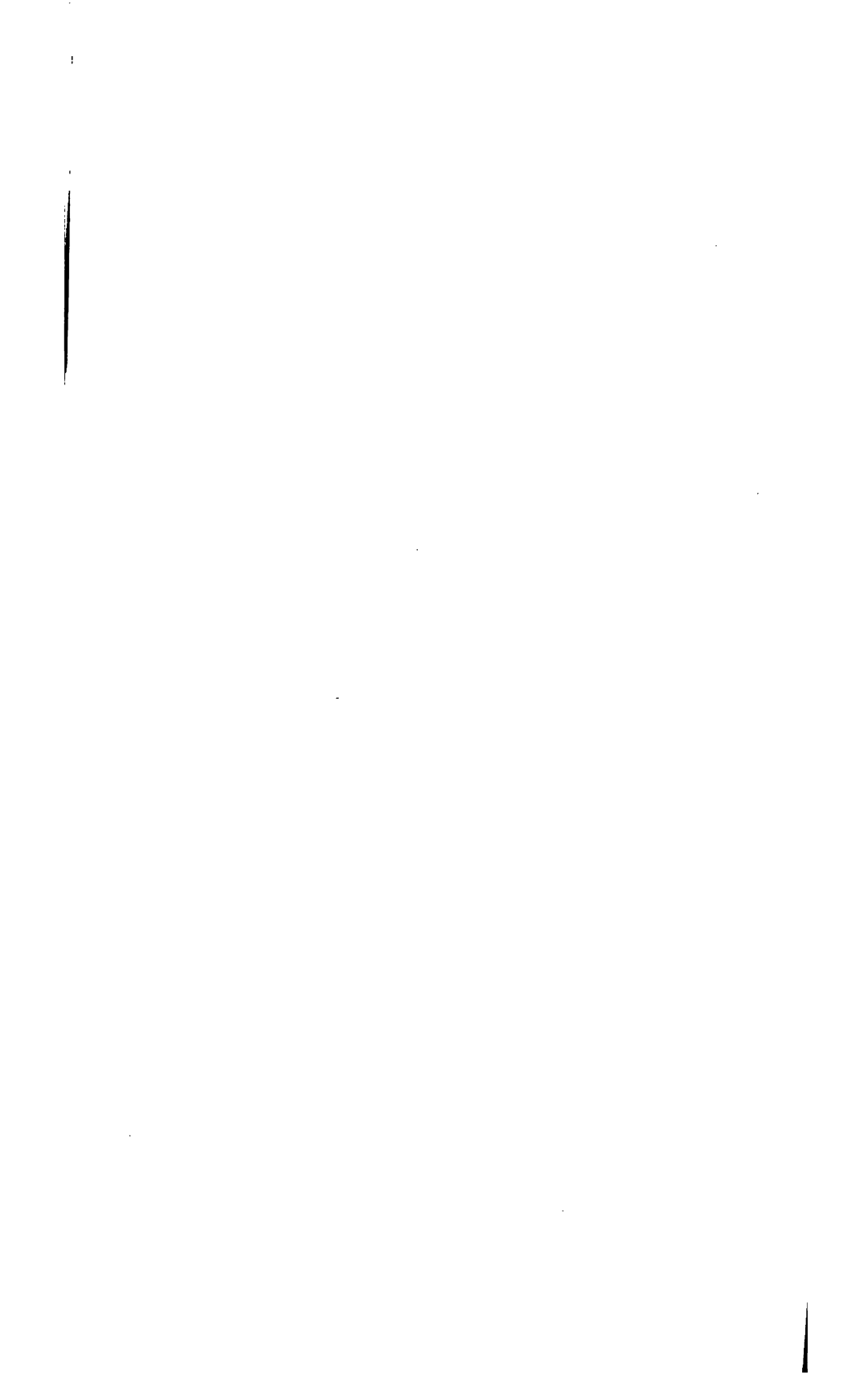
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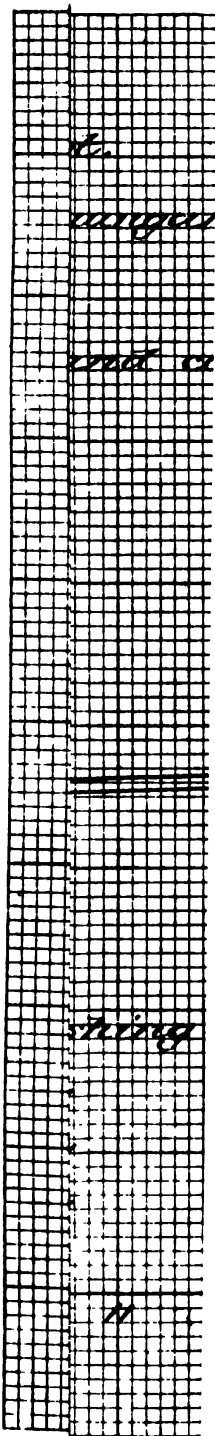
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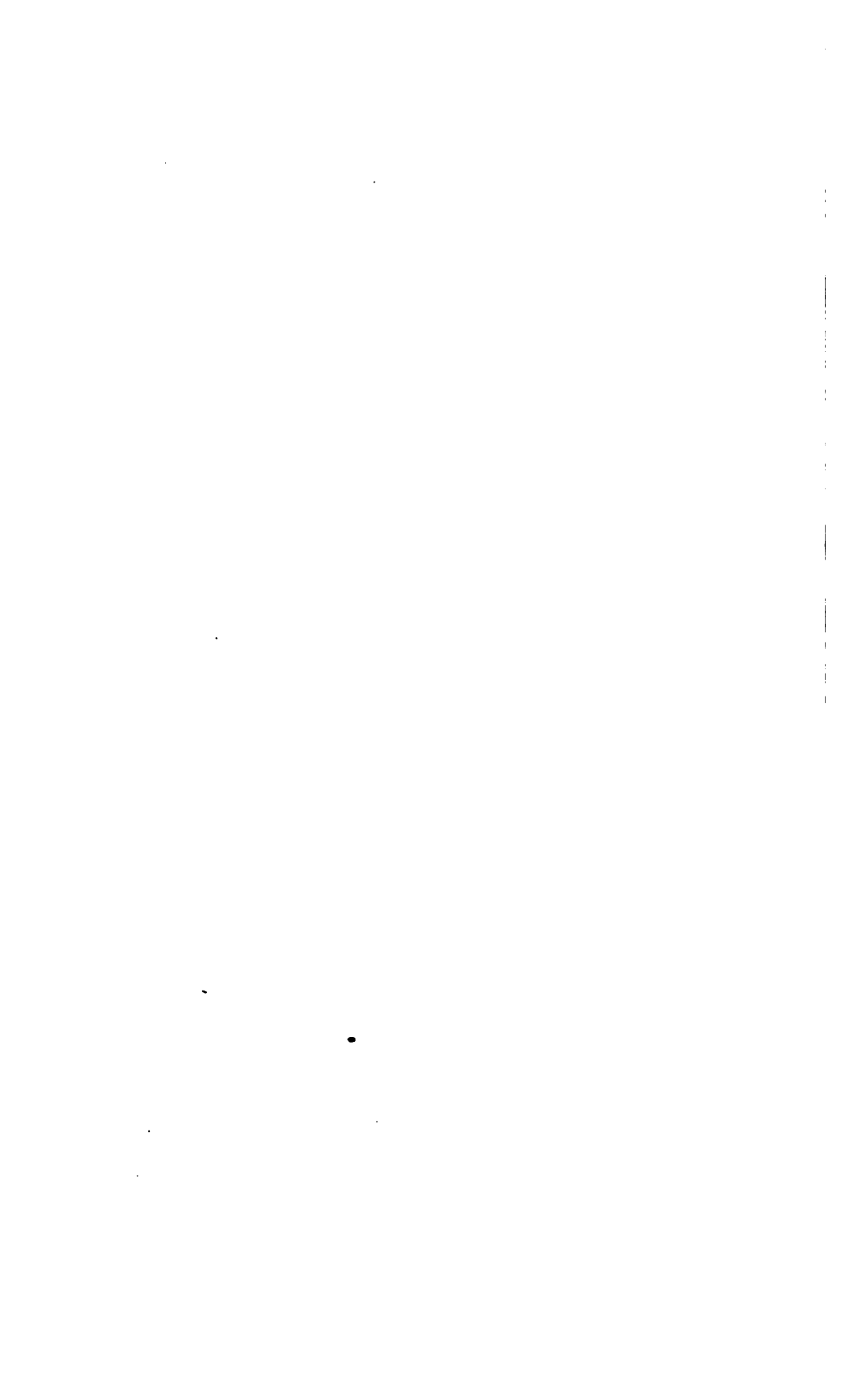


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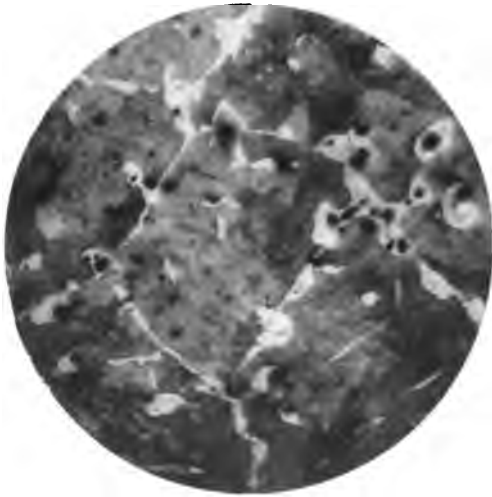
ent and humming
of tensile stress.

nearly same, quenched in water.

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PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-3, NO. 7692, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL IN NATURAL STATE OF INGOT.

METAL FROM 62-INCH OCTAGONAL CARBON STEEL INGOT.

LONGITUDINAL UNFORGED SPECIMENS IN NATURAL STATE OF INGOT
AND AFTER HEAT TREATMENT OF THE STEEL.

No. 7692.

Natural state.

Marks, M 62-3.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
15,000	.0016	0.	
20,000	.0021	.....
25,000	.0028	.0001	
30,000	.0036	.0008	
31,000	.0038	.....
32,000	.0040	.....	Elastic limit.
33,000	.0044	.....
34,000	.0051	.....
35,000	.0067	.0027	
36,000	.0080	.....
37,000	.0092	.....
38,000	.0115	.....
39,000	.0120	.....
40,000	.0149	.0099	
42,000	.0190	.....
44,000	.0224	.....
46,000	.0270	.....
48,000	.0305	.....
50,000	.0360	.0291	
52,000	.0388	.....
54,000	.0435	.....
56,000	.0482	.....
58,000	.0540	.....
60,000	.0590	.0505	
62,000	.0630	.....
62,560	.....	.....	Tensile strength.
0	.06	.....	= 1.7 per cent.

Elongation of inch sections, ".02, ".01, ".02.

Contraction of area, inappreciable.

Appearance of fracture, medium granular, brilliant facets,

No. 7693.

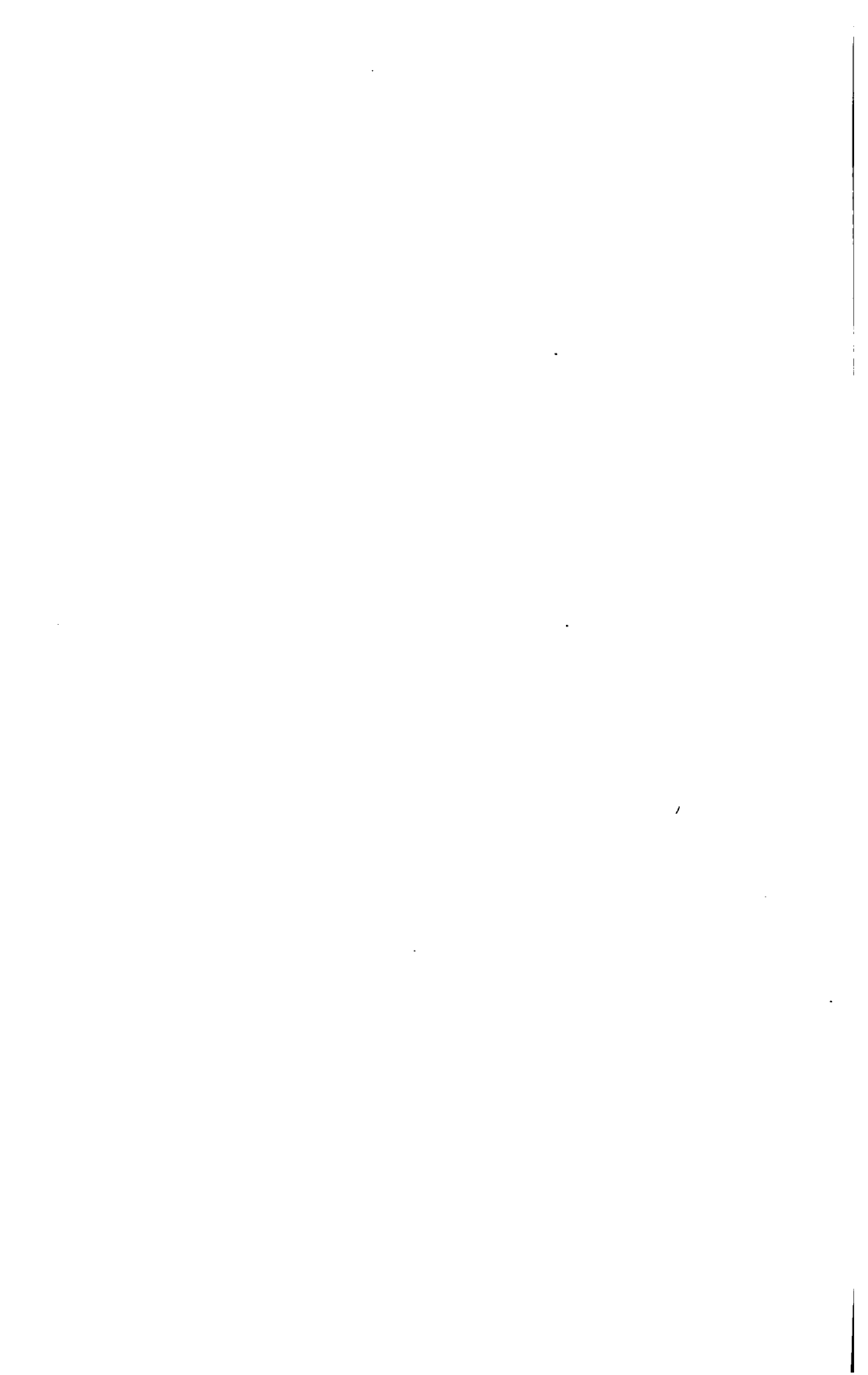
Natural state.
 Marks, M62-6.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	Elastic limit; approximate.
10,000	.0009	.....
15,000	.0014	.....
20,000	.0020	0.	
25,000	.0028	0.	
29,000	.....	.....
30,000	.0039	.0006	
31,000	.0041	.....
32,000	.0049	.....
33,000	.0053	.....
34,000	.0068	.....
35,000	.0081	.0041	
36,000	.0102	.....
37,000	.0116	.....
38,000	.0129	.....
39,000	.0154	.....
40,000	.0180	.0130	
42,000	.0214	.....
44,000	.0260	.....
46,000	.0302	.....
48,000	.0350	.....
50,000	.0410	.0341	
54,000	.05	.....
58,000	.07	.....
60,000	.08	.....
64,000	.09	.....
68,000	.10	.....
72,000	.12	.....
76,000	.15	.....
79,840	Tensile strength = 7.3 per cent.
0	.22	.....

Elongation of inch sections, ".09*, ".06, ".07.
 Diameter at fracture, ".55; area, .2376 square inch.
 Contraction of area, 5 per cent.
 Appearance of fracture, medium granular, brilliant facets.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-6, NO. 7693, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL IN NATURAL STATE OF INGOT.







PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-A, NO. 7694, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BLUE AND COOLED IN SAND.

No. 7694.

Heated to a blue and cooled in dry sand.

Marks, M62-A.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0011	.....
15,000	.0016	.....
20,000	.0021	0.	
25,000	.0027	.0001	
28,000	.0028	.....
27,000	.0029	.....
28,000	.0030	.....
29,000	.0031	.....
30,000	.0032	.0001	Elastic limit.
31,000	.0035	.....
32,000	.0039	.....
33,000	.0042	.....
34,000	.0066	.....
35,000	.0070	.0030	
36,000	.0087	.....
37,000	.0099	.....
38,000	.0123	.....
39,000	.0138	.....
40,000	.0163	.0112	
42,000	.0194	.....
44,000	.0238	.....
46,000	.0278	.....
48,000	.0320	.....
50,000	.0361	.0295	
56,000	.05	.....
60,000	.06	.....
64,000	.08	.....
68,000	.09	.....
72,000	.11	.....
76,000	.14	.....
80,000	.17	.....
84,000	.22	.....
87,840	Tensile strength. = 12 per cent.
0	.36	.....

Elongation of inch sections, ".09, ".17*, ".10.

Diameter at fracture, ".52; area, .2124 square inch.

Contraction of area, 15 per cent.

Appearance of fracture, medium granular.

No. 7695.

Heated to a low red and cooled in dry sand.
 Marks, M62-B.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
15,000	.0018	.....
20,000	.0021	0.	
25,000	.0027	0.	
26,000	.0028	.....
27,000	.0029	.....
28,000	.0030	.....
29,000	.0032	.....		Elastic limit.
30,000	.0035	.0002	
31,000	.0039	.....
32,000	.0042	.....
33,000	.0050	.....
34,000	.0069	.....
35,000	.0088	.0048	
36,000	.0102	.....
37,000	.0118	.....
38,000	.0142	.....
39,000	.0159	.....
40,000	.0180	.0139	
42,000	.0225	.....
44,000	.0268	.....
46,000	.0312	.....
48,000	.0360	.....
50,000	.0420	.0351	
56,000	.05	.....
60,000	.06	.....
64,000	.08	.....
68,000	.10	.....
72,000	.12	.....
76,000	.15	.....
80,000	.21	.....
84,000	Tensile strength. =11 per cent.
0	.33	.....

Elongation of inch sections, ".09, ".10, ".14*.

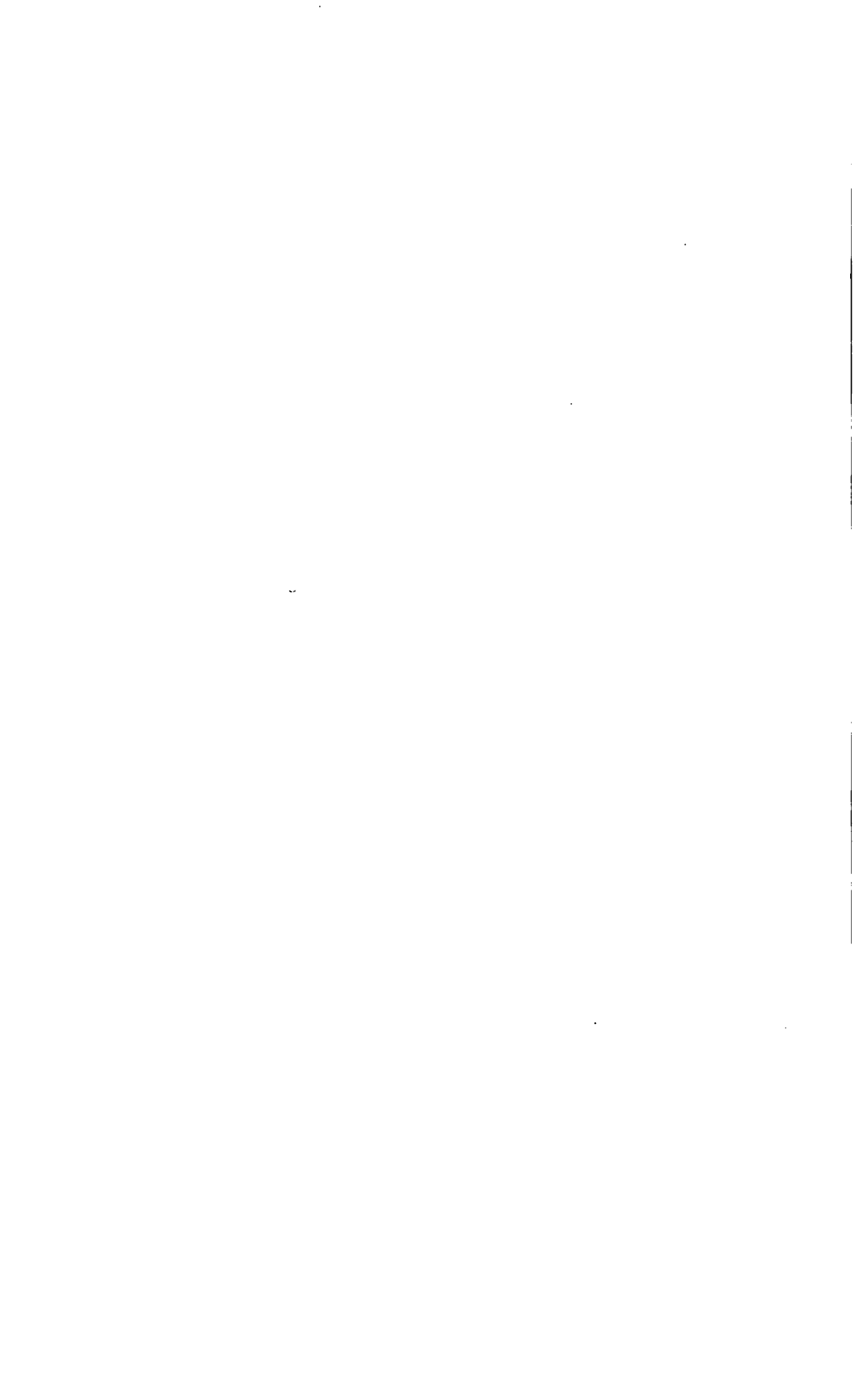
Diameter at fracture, ".53; area, .2206 square inch.

Contraction of area, 11.8 per cent.

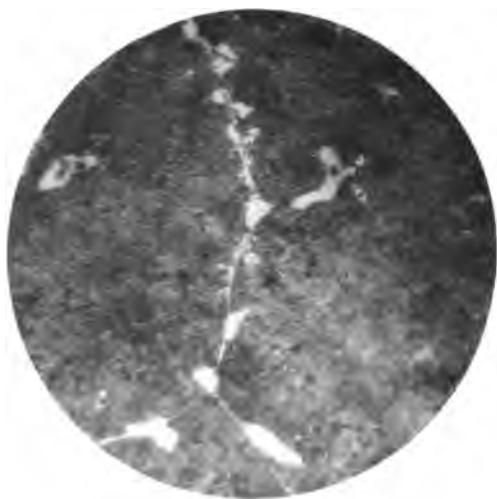
Appearance of fracture, medium granular, brilliant facets.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN ME7-B, NO. 7595, CROSS SECTION.
60-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED LOW RED AND COOLED IN SAND.



100



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-C, NO. 7696, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED CHERRY AND COOLED IN SAND.

No. 7696.

Heated to a cherry color and cooled in dry sand.

Marks, M62-C.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
15,000	.0016	.....
20,000	.0021	.0001	
25,000	.0027	.0001	
30,000	.0032	.0001	
35,000	.0040	.0001	
40,000	.0045	.0002	
45,000	.0053	.0005		Elastic limit.
46,000	.0055	.....
47,000	.0058	.....
48,000	.0065	.....
48,000	.0071	.....
49,000	.0079	.....
50,000	.0108	.0049	
51,000	.0190	.....
52,000	.0400	.....
53,000	.0410	.....
54,000	.0421	.....
55,000	.0448	.....
56,000	.0475	.....
57,000	Tensile strength. =2.3 per cent.
0	.07	.....

Elongation of inch sections, ".04, ".02, ".01.

Contraction of area, inappreciable.

Appearance of fracture, medium granular, brilliant facets; dark colored spot at circumference. Defective specimen.

No. 7697.

Heated to a low yellow and cooled in dry sand.
 Marks, M62-D.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

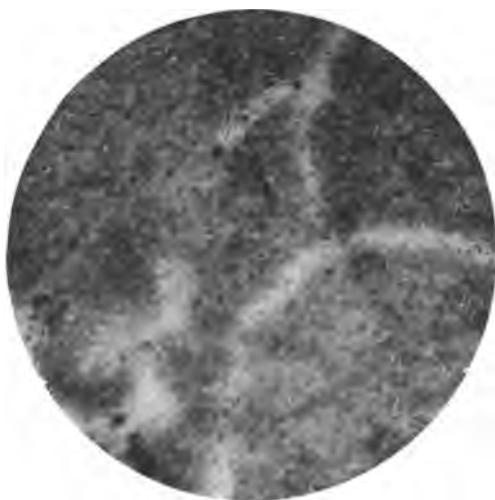
Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	-----	
15,000	.0015	-----	
20,000	.0020	0.	
25,000	.0025	-----	
30,000	.0031	0.	
35,000	.0037	0.	
40,000	.0042	.0001	
45,000	.0049	.0002	
49,000	.0054	-----	
50,000	.0058	-----	
47,000	.0107	-----	
48,000	.0140	-----	
49,000	.0175	-----	
50,000	.0232	.0168	Elastic limit. Load fell.
51,000	.0242	-----	
52,000	.0262	-----	
53,000	.0280	-----	
54,000	.0310	-----	
56,000	.0358	-----	
58,000	.0403	-----	
60,000	.0460	.0378	
64,000	.06	-----	
68,000	.07	-----	
72,000	.08	-----	
76,000	.10	-----	
80,000	.12	-----	
84,000	.14	-----	
88,000	.17	-----	
92,000	.23	-----	
95,920	-----	-----	Tensile strength. =13.7 per cent.
0	.41	-----	

Elongation of inch sections, ".10, ".10, ".21*.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

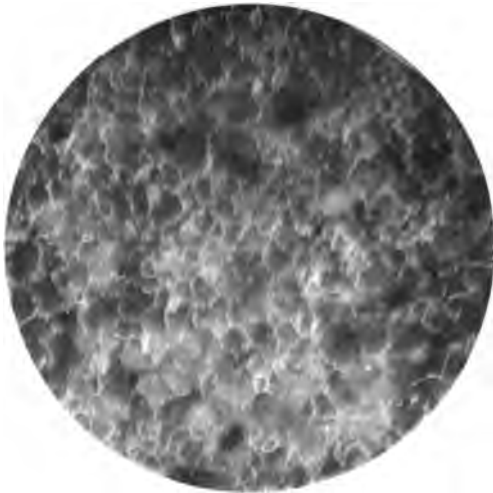
Appearance of fracture, fine granular; silky spot at circumference.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-D, NO. 7697, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED LOW YELLOW AND COOLED IN SAND.







PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-E, NO. 7698, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED BRIGHT YELLOW AND COOLED IN SAND.

No. 7698.

Heated to a bright yellow and cooled in dry sand.
 Marks, M62-E.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	0.	
20,000	.0020	0.	
25,000	.0028	0.	
30,000	.0030	0.	
35,000	.0036	0.	
40,000	.0041	0.	
45,000	.0047	0.	
50,000	.0064	.0002		Elastic limit.
51,000	.0069	0.	
52,000	.0072	0.	
53,000	.0090	0.	
54,000	.0130	0.	
55,000	.0168	.0100	
56,000	.0192	0.	
58,000	.0220	0.	
60,000	.0262	.0187	
64,000	.03	0.	
68,000	.04	0.	
72,000	.05	0.	
76,000	.06	0.	
80,000	.07	0.	
84,000	.09	0.	
88,000	.10	0.	
92,000	.12	0.	
96,000	.15	0.	
99,200	0.	0.	Tensile strength. =4.7 per cent.
0	.14	0.	

Elongation of inch sections, ".05, ".05, ".04.
 Contraction of area, inappreciable.
 Appearance of fracture, fine granular.

No. 7699.

Heated white hot and cooled in dry sand.

Marks, M 62-F.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

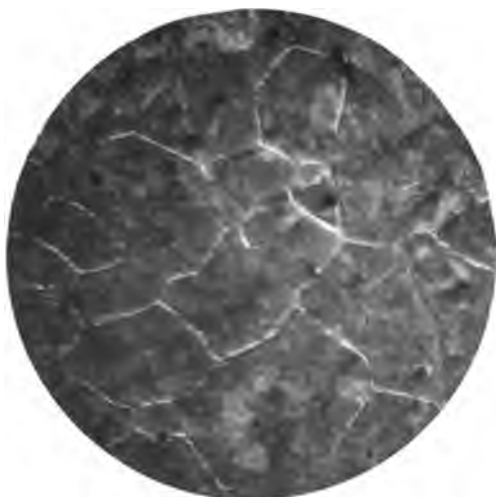
Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009		
20,000	.0019	— .0001	
25,000	.0024		
30,000	.0030	— .0001	
35,000	.0036	0.	
40,000	.0040	0.	
45,000	.0046	0.	
50,000	.0058	.0001		Elastic limit.
51,000	.0056	.....
52,000	.0058	.....
53,000	.0061	.....
54,000	.0064	.....
55,000	.0068	.0010	
56,000	.0075	.....
57,000	.0081	.....
58,000	.0089	.....
59,000	.0099	.....
60,000	.0113	.0047	
62,000	.0138	.....
64,000	.0165	.....
66,000	.0200	.....
68,000	.0234	.....
70,000	.0272	.0185	
72,000	.03	.....
76,000	.04	.....
80,000	.05	.....
84,000	.06	.....
88,000	.07	.....
92,000	.08	.....
96,000	.09	.....
100,000	.10	.....
104,000	.13	.....
108,000	.15	.....
112,000	.20	.....
115,600	Tensile strength. =8.7 per cent.
0	.26	.....

Elongation of inch sections, ".08, ".08, ".10*.

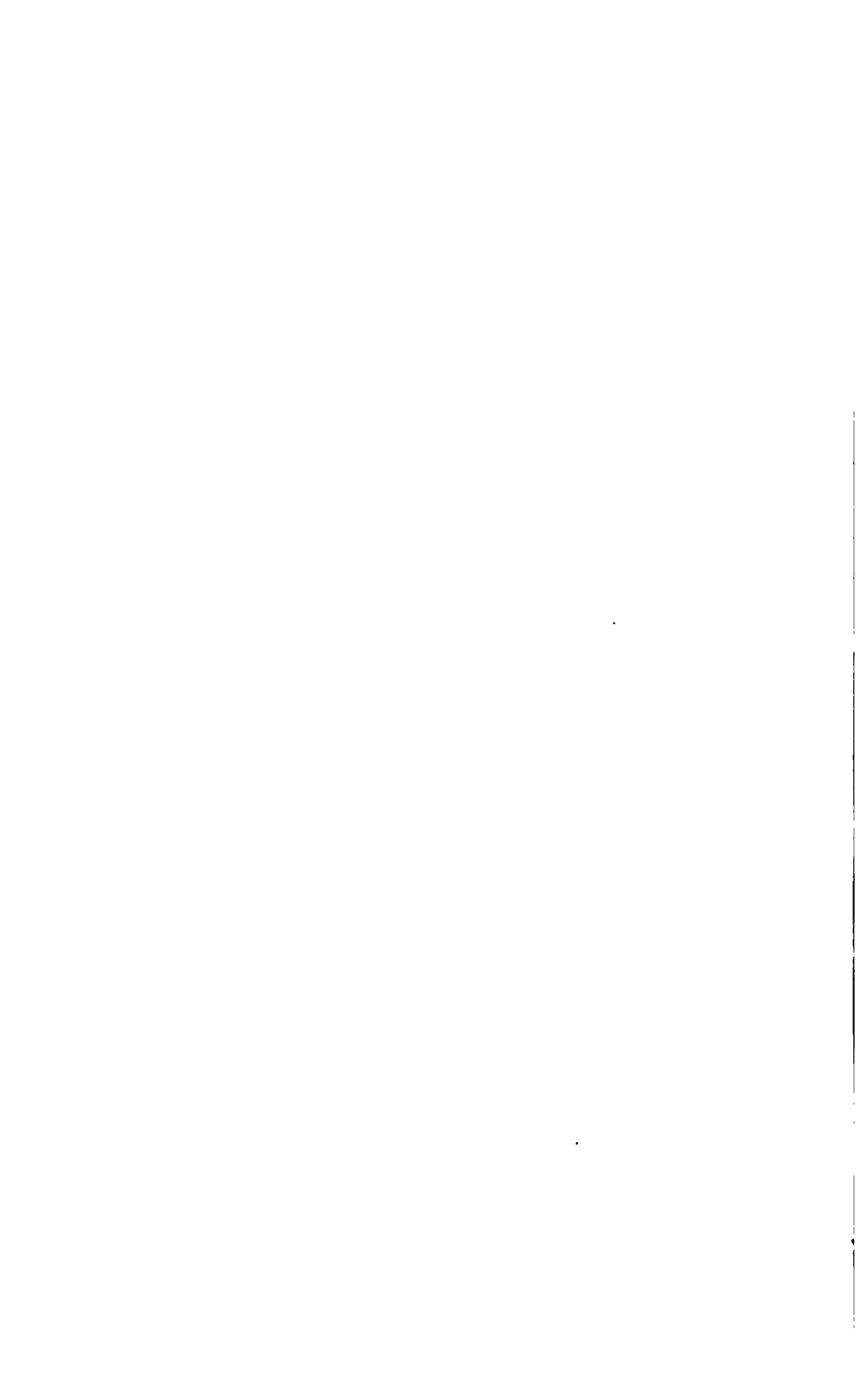
Diameter at fracture, ".54; area, .2290 square inch.

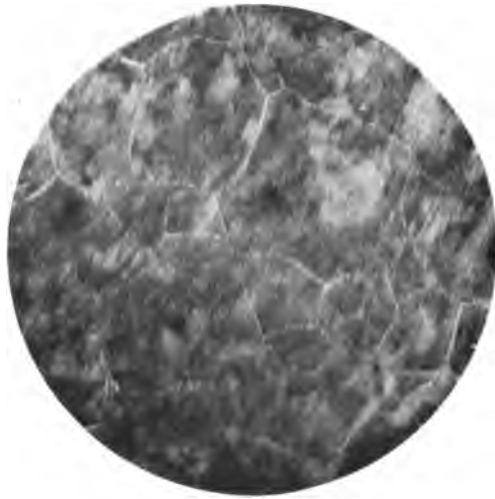
Contraction of area, 8.4 per cent.

Appearance of fracture, fine granular.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-F, NO. 7699, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT AND COOLED IN SAND.





PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-G, NO. 7700, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED NEARLY SCINTILLATING HOT AND COOLED IN SAND.

No. 7700.

Heated to nearly a scintillating temperature, cooled in dry sand.

Marks, M 62-G.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0004	0.		
10,000	.0010	0.		
20,000	.0020	0.		
30,000	.0030	0.		
35,000	.0038	0.		
40,000	.0041	0.		
45,000	.0047	0.		
48,000	.0051	0.		
49,000	.0052	0.		
50,000	.0056	.0003		Elastic limit.
51,000	.0060	0.		
52,000	.0066	0.		
53,000	.0069	0.		
54,000	.0075	0.		
55,000	.0083	.0022		
56,000	.0095	0.		
57,000	.0102	0.		
58,000	.0115	0.		
59,000	.0129	0.		
60,000	.0148	.0078		
62,000	.0180	0.		
64,000	.0219	0.		
66,000	.0253	0.		
68,000	.0294	0.		
70,000	.0335	.0247		
72,000	.04	0.		
76,000	.05	0.		
80,000	.06	0.		
84,000	.07	0.		
88,000	.08	0.		
92,000	.10	0.		
96,000	.12	0.		
100,000	.14	0.		
104,000	.17	0.		
107,040	0	0	Tensile strength.	
0	.20	0	--6.7 per cent.	

Elongation of inch sections, ".06, ".07*, ".07.

Diameter at fracture, ".55; area, .2376 square inch.

Contraction of area, 5 per cent.

Appearance of fracture, fine granular.

No. 7701.

Heated white hot, quenched in oil, annealed at blue heat.

Marks, M62-J.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0009	0.	
20,000	.0019	0.	
30,000	.0029	0.	
35,000	.0034	0.	
40,000	.0039	0.	
45,000	.0045	0.	
50,000	.0050	0.	
55,000	.0056	0.	
60,000	.0061	0.	
65,000	.0067	0.	
70,000	.0073	0.	
72,800	.08	0.	Tensile strength. =1 per cent.
0			

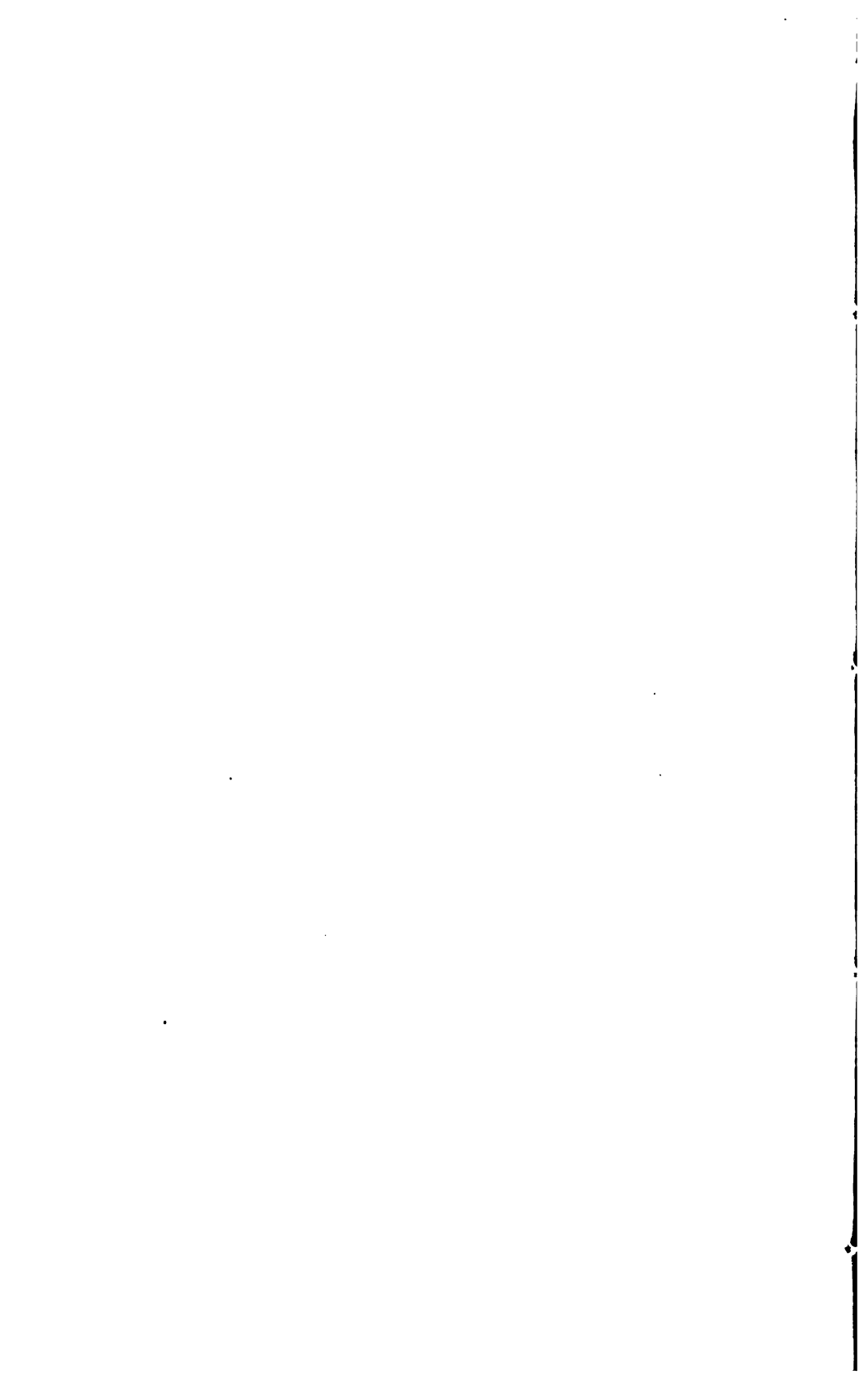
Elongation of inch sections, ".03*", ".00, ".00.

Contraction of area, inappreciable.

Appearance of fracture, medium fine granular, brilliant facets.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-J, NO. 7701, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT, QUENCHED IN OIL,
AND ANNEALED AT BLUE.



No. 7702.

Heated white hot, quenched in oil, annealed at blood-red heat.

Marks, M 62-K.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	0.	
20,000	.0020	0.	
30,000	.0031	0.	
35,000	.0036	0.	
40,000	.0041	0.	
45,000	.0046	0.	
50,000	.0051	0.	
55,000	.0056	0.	
60,000	.0061	0.	
65,000	.0066	0.	
70,000	.0072	0.	
75,000	.0079	0.	
78,000	.....	.....		Elastic limit; approximate.
80,000	.0087	.0003	
81,000	.0089	.....
82,000	.0091	.....
83,000	.0095	.....
84,000	.0099	.....
85,000	.0102	.0012	
92,000	.02	.....
95,000	.04	.....
100,000	.06	.....
104,000	.09	.....
108,000	.11	.....
112,000	.17	.....
113,600	Tensile strength. =11 per cent.
0	.83	.....

Elongation of inch sections, ".08, ".20*, ".05.

Diameter at fracture, ".47; area, .1735 square inch.

Contraction of area, 30.6 per cent.

Appearance of fracture, dull silky, irregular, oblique.

No. 7703.

Heated white hot, quenched in oil, annealed at cherry color.
 Marks, M62-L.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

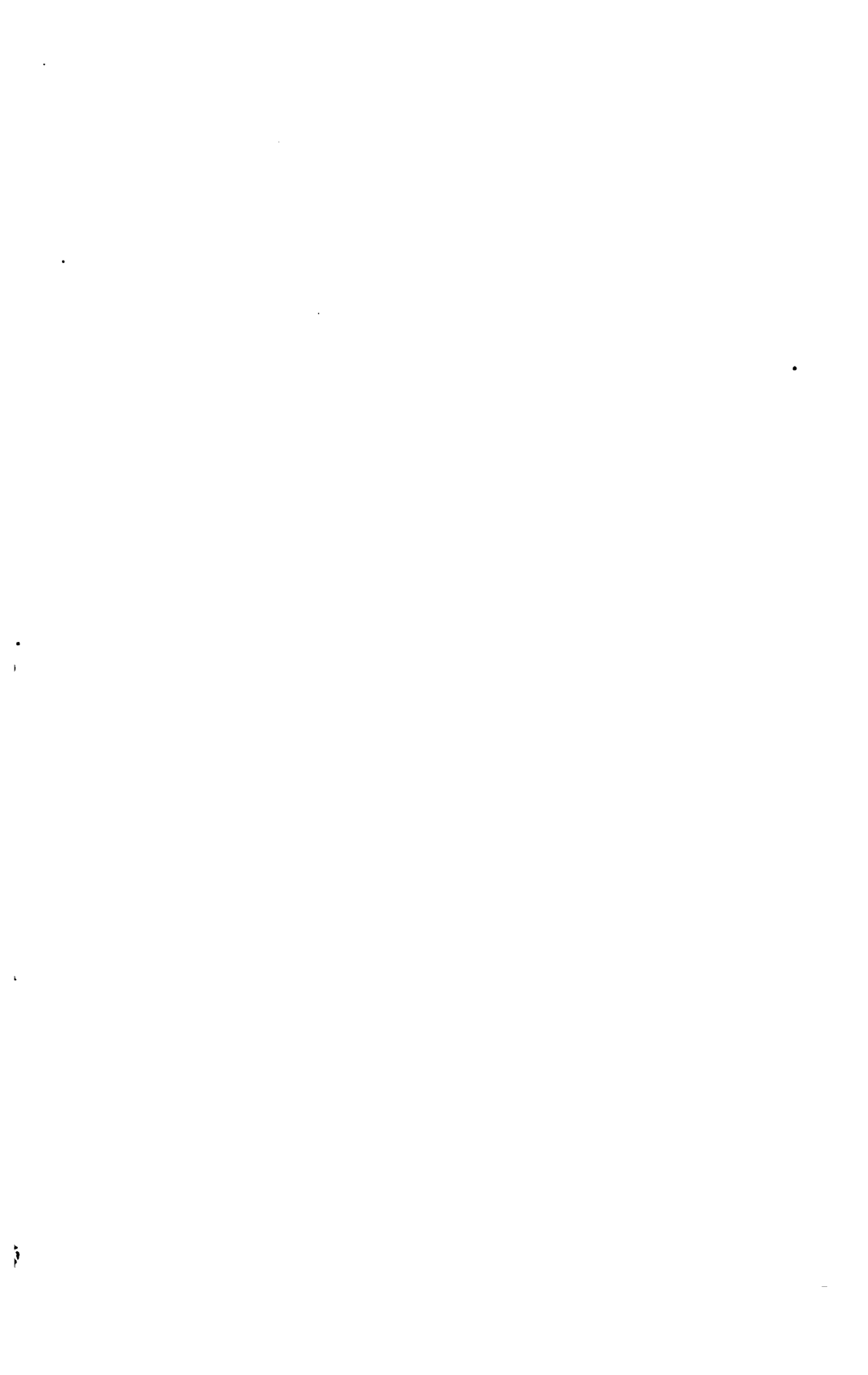
Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load	
1,000	0.	0.		
5,000	.0003	0.		
10,000	.0009	0.		
20,000	.0019	0.		
30,000	.0030	0.		
35,000	.0035	0.		
40,000	.0040	0.		
45,000	.0046	0.		
50,000	.0051	0.		
60,000	.0061	0.		
64,000	.0067	0.		
64,800		Elastic limit. Load fell.
60,000	.0109	.....	
61,000	.0216	.....	
62,000	.0410	.....	
63,000	.0416	.....	
64,000	.0432	.0349		
68,000	.06	.....	
72,000	.07	.....	
76,000	.08	.....	
80,000	.09	.....	
84,000	.11	.....	
88,000	.13	.....	
92,000	.15	.....	
96,000	.19	.....	
100,000	.23	.....	
108,200	Tensile strength. =10 per cent.	
0	.30	.....	

Elongation of inch sections, ".09, ".12, ".09.

Diameter at fracture, ".52; area, .2124 square inch.

Contraction of area, 15 per cent.

Appearance of fracture, fine granular, flaky, radiating from silky metal at the circumference.





PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-M, NO. 7704, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT, QUENCHED IN OIL, AND ANNEALED AT BRIGHT YELLOW.

No. 7704.

Heated white hot, quenched in oil, annealed at bright yellow.

Marks, M62-M.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0004	0.		
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	0.		
35,000	.0035	.....	
40,000	.0040	0.		
50,000	.0052	.0002		Elastic limit.
55,000	.0073	.0019		
56,000	.0102	.....	
57,000	.0127	.....	
58,000	.0145	.....	
59,000	.0164	.....	
60,000	.0185	.0111		
62,000	.0218	.....	
64,000	.0252	.....	
66,000	.0288	.....	
68,000	.0328	.....	
70,000	.0365	.0270	Tensile strength. = 13.3 per cent.	
76,000	.05	.....	
80,000	.06	.....	
84,000	.07	.....	
88,000	.09	.....	
92,000	.10	.....	
96,000	.12	.....	
100,000	.14	.....	
104,000	.16	.....	
108,000	.21	.....	
112,000	.33	.....	
0	.40	.....	

Elongation of inch sections, ".18", ".10", ".12.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

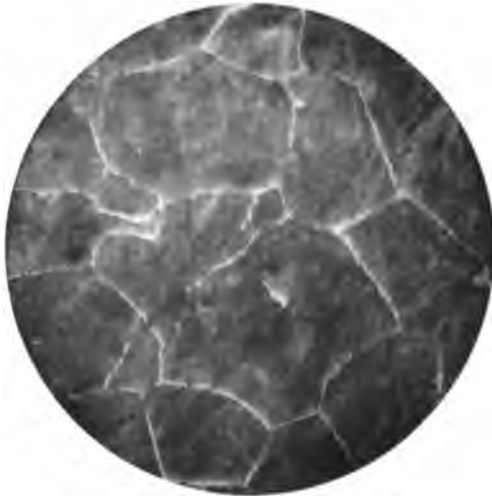
Appearance of fracture, fine granular, silky center.

No. 7705.

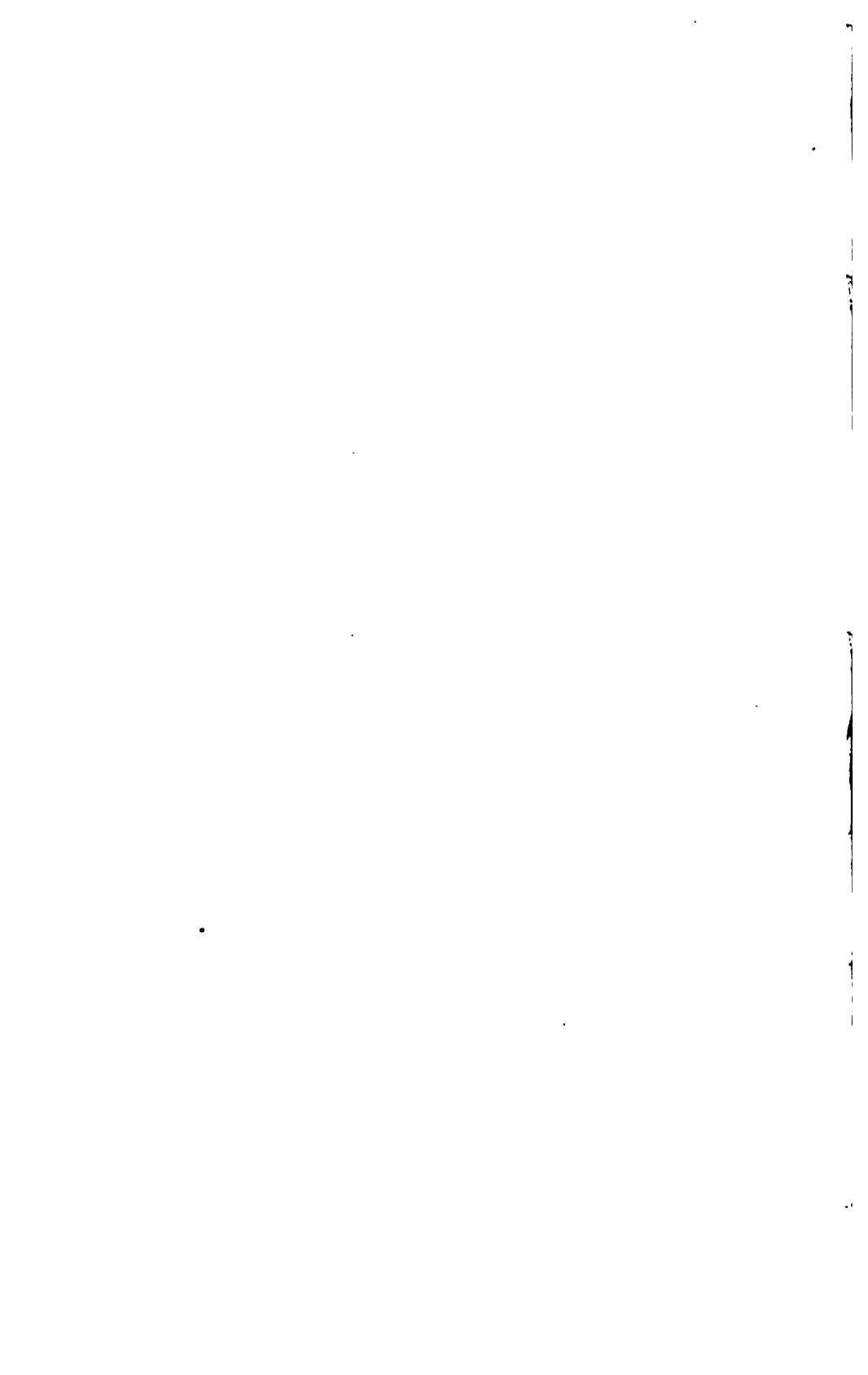
Heated white hot, quenched in oil, annealed at white heat.
 Marks, M62-N.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
20,000	.0020	0.	
30,000	.0081	0.	
35,000	.0086	0.	
40,000	.0042	.0001	Elastic limit.
45,000	.0049	.0001	
46,000	.0051		
47,000	.0058		
48,000	.0057		
49,000	.0060		
50,000	.0063	.0010	
51,000	.0068		
52,000	.0072		
53,000	.0080		
54,000	.0089		
55,000	.0099	.0089	
56,000	.0112		
58,000	.0142		
60,000	.0180	.0108	
62,000	.0210		
64,000	.0250		
66,000	.0285		
68,000	.0332		
70,000	.0385	.0298	
76,000	.06		
80,000	.06		
84,000	.07		
88,000	.09		
92,000	.11		
96,000	.13		
100,000	.15		Tensile strength.
104,000			= 6.3 per cent.
0	.19		

Elongation of inch sections, ".07, ".05, ".07*.
 Diameter at fracture, ".54; area, .2290 square inch.
 Contraction of area, 8.4 per cent.
 Appearance of fracture, medium granular, brilliant facets.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-N, NO. 7705, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED WHITE HOT, QUENCHED IN OIL,
AND ANNEALED AT WHITE HEAT.



No. 7706.

Heated to a cherry color and quenched in oil.

Marks, M 62-O.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0030	0.	
35,000	.0036	0.	
40,000	.0042	.0001	
45,000	.0048	.0001	
50,000	.0055	.0002	
55,000	.0060	.....
60,000	.0069	.0005	
65,000	.0075	.0007	
70,000	.0082	.0009	
75,000	.0090	.0011	
80,000	.0108	.0024	
85,000	.0138	.0044	
92,000	.03	.....
100,000	.04	.....
104,000	.05	.....
108,000	.06	.....
112,000	.07	.....
116,000	.08	.....
120,000	.10	.....
124,000	.12	.....
126,000	Tensile strength.
0	.13	= 4.3 per cent.

Elastic limit indefinite.

Elongation of inch sections, ".02, ".04, ".07*.

Diameter at fracture, ".55; area, .2376 square inch.

Contraction of area, 5 per cent.

Appearance of fracture, granular, flaky.

H. Doc. 521, 58-2—20

No. 7707.

Heated to a cherry color, quenched in oil, annealed at about 1,000° F.

Marks, M62-R.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

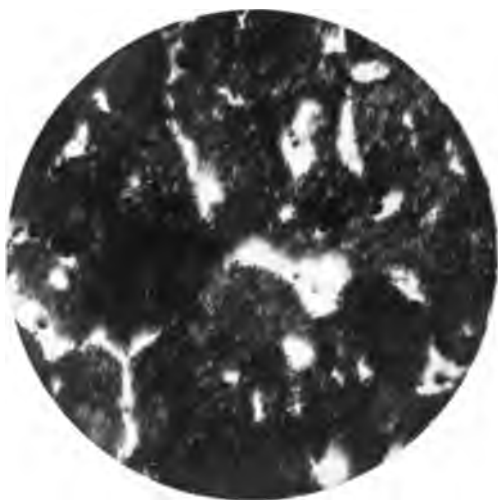
Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0009	.....
20,000	.0019	.....
30,000	.0030	0.	
35,000	.0035	.....
40,000	.0040	0.	
45,000	.0046	.....
50,000	.0052	.0001	
55,000	.0059	.....
60,000	.0066	.0002	
65,000	.0071	.....
70,000	.0079	.0005	
75,000	.0088	0009	
78,000	.0099	.....
80,000	.0130	.0042	
88,000	.03	.....
92,000	.04	.....
96,000	.06	.....
100,000	.07	.....
104,000	.08	.....
108,000	.10	.....
112,000	.12	.....
113,600	.....	.....
0	.10	.....
			Tensile strength. =3.3 per cent.

Elastic limit indefinite.

Elongation of inch sections, ".04, ".03, ".03.

Contraction of area, inappreciable.

Appearance of fracture, medium granular, flaky. Opened cracks in stem in vicinity of place of rupture.



PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN M62-R, NO. 7707, CROSS SECTION.
62-INCH CARBON STEEL INGOT. MAGNIFICATION 53 DIAMETERS.
STEEL HEATED CHERRY, QUENCHED IN OIL, AND ANNEALED AT 1000 + DEG. F.

No. 7708.

Heated low yellow, quenched in oil, annealed at about 1,000° F.
 Marks, M62-S.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0031	0.	
35,000	.0036	.....
40,000	.0041	0.	
45,000	.0046	.....
50,000	.0051	0.	
55,000	.0057	.....
60,000	.0061	0.	
65,000	.0067	.....
70,000	.0072	0.	
75,000	.0078	.....
80,000	.0082	0.	
85,000	.0088	.....
90,000	.0093	.0001	
95,000	.0100	.....
100,000	.0107	.0002	
105,000	.0114	.....
108,000	.0120	.....
110,000	.0125	.0010	
120,000	.02	.....
128,000	.03	.....
136,000	.04	.....
144,000	.07	.....
150,000	Tensile strength.
0	.16	=5 per cent.

Elastic limit, indefinite.

Elongation of inch sections, ".04, ".10*, ".01.

Diameter at fracture, ".54; area, .2290 square inch.

Contraction of area, 8.4 per cent.

Appearance of fracture, dull silky, interspersed with fine granulation.

No. 7709.

Heated bright yellow, quenched in oil, annealed at about 1,000° F.
 Marks, M 62-T.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

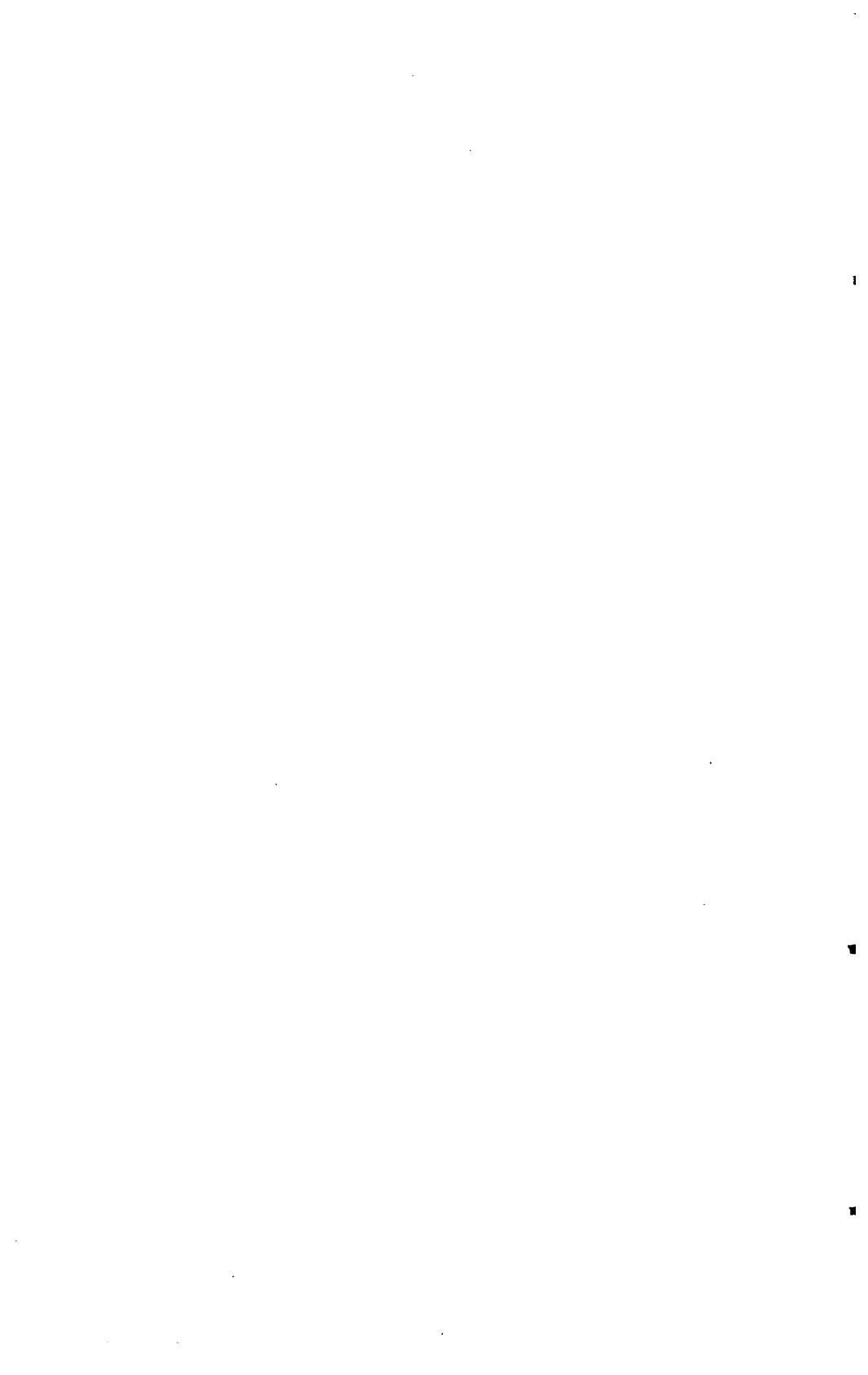
Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0020	.....
30,000	.0030	0.	
35,000	.0036	.....
40,000	.0041	0.	
45,000	.0046	.....
50,000	.0051	0.	
55,000	.0056	.....
60,000	.0061	0.	
65,000	.0067	.....
70,000	.0072	0.	
75,000	.0077	.....
80,000	.0082	0.	
85,000	.0087	.....
90,000	.0092	0.	
95,000	.0098	.....
100,000	.0103	0.	
105,000	.0108	.....
110,000	.0113	0.	
115,000	.0119	.....
120,000	.0126	.0002	
136,000	.02	.....
144,000	.03	.....
152,000	.05	.....
156,200	.....	.....
0	.12	Tensile strength. =4 per cent.

Elongation of inch sections, ".01, ".04, ".07*.
 Diameter at fracture, ".54; area, .2290 square inch.
 Contraction of area, 8.4 per cent.
 Appearance of fracture, silky, interspersed with fine granulation.

TABULATION OF TENSION SPECIMENS FROM 62-INCH OCTAGONAL CARBON STEEL INGOT.
LONGITUDINAL, UNFORGED SPECIMENS IN NATURAL STATE OF THE INGOT AND AFTER HEAT TREATMENT OF THE STEEL.
STEMS OF SPECIMENS, 1.564 DIAMETER, 3rd LONG.

No. of test.	Treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 8 inches.		Contraction of area.		Elongation of inch sections.		Appearance of fracture.
				Per cent.	Per cent.	Per cent.	Per cent.	"	"	
7692	Natural state.	Pounds. 82,000	Pounds. 82,560	1.7	0.2	(a)	0.01	"	Medium granular; brilliant facets.	
7693	Do.	b 25,000	79,840	7.3	0.98	5.0	0.06	0.07	Do.	
7694	Heated blue and cooled in dry sand.	30,000	87,840	12.0	0.98	16.0	0.09	0.10	Medium granular; brilliant facets.	
7695	Heated low red and cooled in dry sand.	25,000	84,000	11.0	0.99	11.8	0.09	0.10	Medium granular; brilliant facets; dark spot at circumference.	
7696	Heated cherry and cooled in dry sand.	45,000	87,600	2.3	0.04	(a)	0.02	0.01	Medium granular; brilliant facets; dark spot at circumference.	
7697	Heated low yellow and cooled in dry sand.	49,000	95,920	13.7	21.4	21.4	0.10	0.10	Fine granular; silky spot at circumference.	
7698	Heated bright yellow and cooled in dry sand.	50,000	99,200	4.7	(a)	8.4	0.08	0.04	Fine granular.	
7699	Heated white hot and cooled in dry sand.	50,000	115,600	8.7	8.4	5.0	0.08	0.10*	Do.	
7700	Heated to nearly scintillating heat and cooled in dry sand.	49,000	107,040	6.7	(a)	5.0	0.08	0.07	Medium fine granular; brilliant facets.	
7701	Heated white hot, quenched in oil, annealed at blue.	(c)	72,800	1.0	(a)	30.6	0.08*	0.00	Dull silky, irregular, oblique.	
7702	Heated white hot, quenched in oil, annealed at blood red.	b 78,000	113,600	11.0	30.6	30.6	0.08	0.20*	Do.	
7703	Heated white hot, quenched in oil, annealed at cherry.	64,800	103,200	10.0	15.0	15.0	0.09	0.12*	Fine granular, flaky, radiating from silky metal at the circumference.	
7704	Heated white hot, quenched in oil, annealed at bright yellow.	50,000	112,000	13.3	21.4	18*	0.10	0.12	Fine granular, silky center.	
7705	Heated white hot, quenched in oil, annealed at white heat.	45,000	104,000	6.3	8.4	0.7	0.05	0.07*	Medium granular; brilliant facets.	
7706	Heated cherry and quenched in oil.	(a)	128,000	4.3	5.0	0.2	0.04	0.04*	Granular, flaky.	
7707	Heated cherry, quenched in oil, annealed at about 1,000° F.	(c)	113,600	3.3	(a)	0.4	0.08	0.08	Medium granular, flaky. Opened cracks in place of rupture.	
7708	Heated low yellow, quenched in oil, annealed at about 1,000° F.	(c)	150,000	5.0	8.4	0.4	0.10*	0.01	Dull silky, interspersed with fine granulation.	
7709	Heated bright yellow, quenched in oil, annealed at about 1,000° F.	(c)	169,200	4.0	8.4	0.1	0.04	0.07*	Silky, interspersed with fine granulation.	

* Defective specimen. a Inappreciable. b Approximate. c Indefinite.

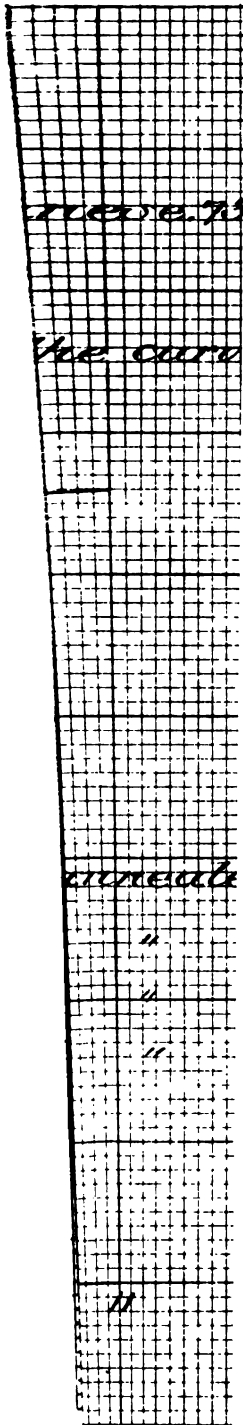


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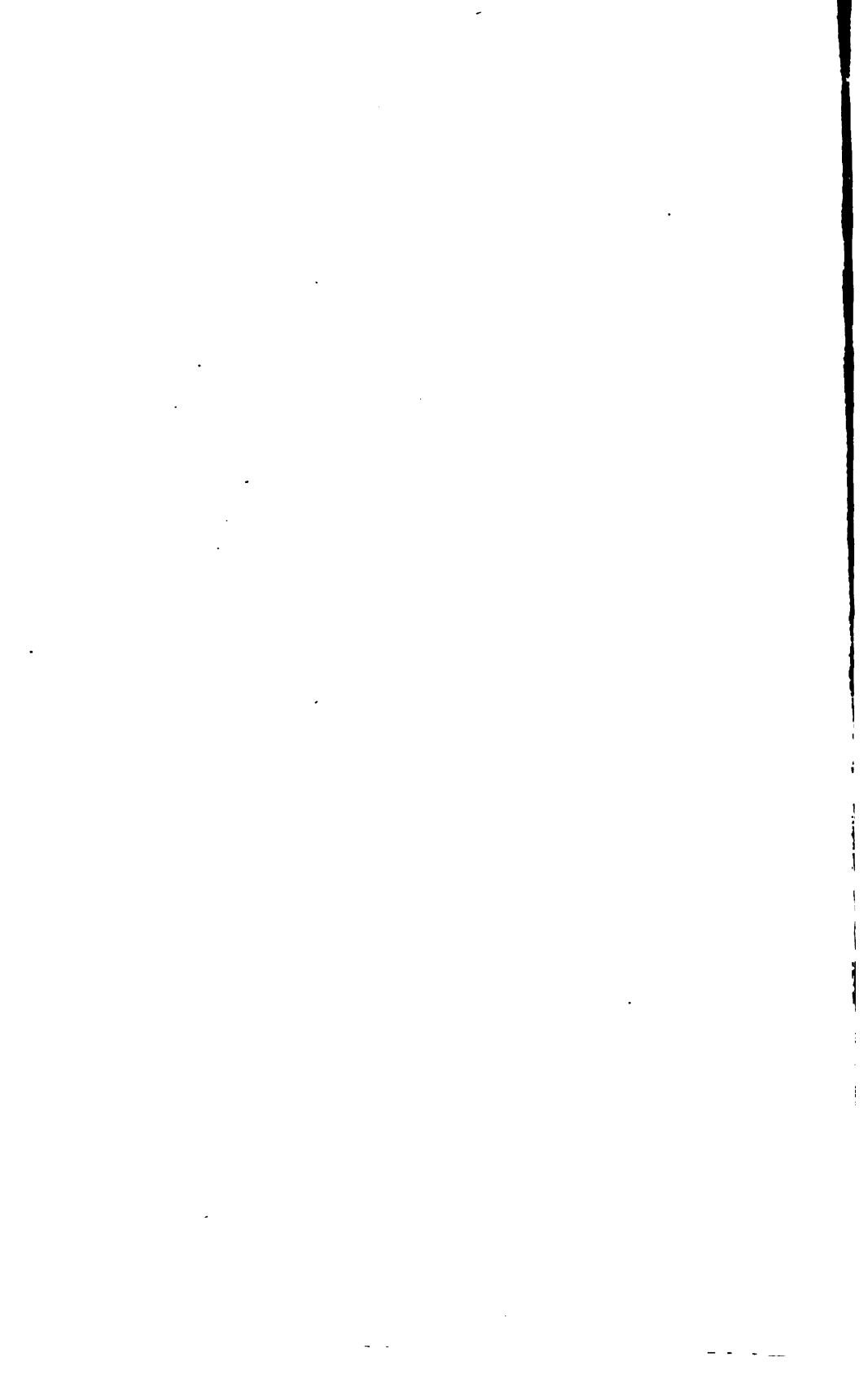
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ENDURANCE OF ROTATING SHAFTS.



ENDURANCE OF ROTATING SHAFTS.

DETAILS OF TESTS.

No. 326.

Marks, 7×2, 9.

Turned down from bar 1¼" diameter. 0.25 per cent carbon. Hardened.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Max-imum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 45,000	1,000	1,000	a	.1638	.1261	.1686	.0375	.0002		
			b	.1645	.1266	.1644	.0378	.0001		
			c	.1633	.1258	.1630	.0372	.0003		
	10,000	11,000	a	.1637	.1261	.1637	.0376	0.		
			b	.1645	.1268	.1643	.0375	.0002		
			c	.1638	.1255	.1630	.0375	.0003		
	24,989,000	25,000,000	a	.1633	.1255	.1632	.0377	.0001		
			b	.1642	.1261	.1640	.0379	.0002		
			c	.1648	.1270	.1647	.0377	.0001		
	50,000	0	25,000,000	a	.1634	.1213	.1632	.0419		.0002
				b	.1643	.1222	.1640	.0418		.0003
				c	.1648	.1228	.1647	.0419		.0001
10,000		25,010,000	a	.1632	.1211	.1630	.0419	.0002		
			b	.1642	.1220	.1640	.0420	.0002		
			c	.1649	.1227	.1647	.0420	.0002		
90,000		25,100,000	a	.1633	.1210	.1630	.0420	.0003		
			b	.1640	.1221	.1640	.0419	0.		
			c	.1648	.1226	.1647	.0421	.0001		
14,900,000		40,000,000	a	.1632	.1210	.1629	.0419	.0003		
			b	.1637	.1217	.1638	.0421	.0001		
			c	.1649	.1223	.1647	.0424	.0002		
55,000	0	40,000,000	a	.1630	.1163	.1627	.0464	.0003		
			b	.1643	.1176	.1639	.0463	.0004		
			c	.1649	.1185	.1648	.0463	.0001		
	1,000	40,001,000	a	.1632	.1167	.1627	.0460	.0005		
			b	.1643	.1179	.1640	.0461	.0003		
			c	.1650	.1185	.1647	.0462	.0003		
	9,000	40,010,000	a	.1632	.1162	.1626	.0464	.0006		
			b	.1643	.1176	.1640	.0464	.0003		
			c	.1651	.1184	.1647	.0463	.0004		
	90,000	40,100,000	a	.1633	.1163	.1625	.0462	.0008		
			b	.1645	.1177	.1639	.0462	.0006		
			c	.1653	.1185	.1647	.0462	.0006		
	100,000	40,200,000	a	.1629	.1161	.1624	.0463	.0005		
			b	.1645	.1174	.1637	.0463	.0003		
			c	.1653	.1179	.1645	.0466	.0006		
	161,250	40,361,250	Bar ruptured .80 south of the south edge of north middle bearing.	

Turned down from bar $1\frac{1}{4}$ " diameter. 0.26 per cent carbon. Hardened.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 45,000	0	0	a	<i>Inch.</i> .1632	<i>Inch.</i> .1263	<i>Inch.</i> .1630	<i>Inch.</i> .0367	<i>Inch.</i> .0002		
			b	.1637	.1267	.1635	.0368	.0002		
	1,000	1,000	a	.1636	.1266	.1634	.0368	.0002		
			b	.1633	.1265	.1630	.0365	.0003		
	9,000	10,000	a	.1637	.1269	.1636	.0367	.0001		
			b	.1630	.1263	.1632	.0369	.0002		
	90,000	100,000	a	.1638	.1265	.1635	.0370	.0008		
			b	.1633	.1260	.1630	.0370	.0008		
	14,900,000	15,000,000	a	.1635	.1265	.1635	.0370	0.		
			b	.1633	.1260	.1631	.0371	.0002		
	50,000	0	15,000,000	a	.1636	.1226	.1635	.0409		.0001
				b	.1632	.1219	.1630	.0411		.0002
1,000		15,001,000	a	.1637	.1224	.1635	.0411	.0002		
			b	.1634	.1218	.1630	.0412	.0004		
9,000		15,010,000	a	.1635	.1220	.1632	.0412	.0003		
			b	.1632	.1216	.1628	.0412	.0004		
1,861,000		16,871,000	-----	-----	-----	-----	-----	-----	Bar ruptured at the south edge of south middle bearing.	

No. 335.

Marks, 7x2, 2.

Turned down from bar 1 1/4" diameter. 0.25 per cent carbon. Annealed at low heat.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maxi- mum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				De- fec- tions.	Sets.	Remarks.
	Successive.	Total.	On line.	Un- load- ed.	Load- ed.	Un- load- ed.			
Pounds. 45,000	0	0	a	Inch. .1637	Inch. .1267	Inch. .1636	Inch. .0369	.0001	
			b	.1637	.1266	.1635	.0369			.0002
	1,000	1,000	a	.1640	.1270	.1640	.0370	0.	.0001
			b	.1634	.1265	.1633	.0368		
	9,000	10,000	a	.1641	.1270	.1640	.0370	.0001	.0001
			b	.1633	.1261	.1632	.0371		
90,000	100,000	a	.1644	.1268	.1641	.0373	.0008	.0004	
		b	.1633	.1255	.1629	.0374			
13,900,000	14,000,000	a	.1644	.1267	.1640	.0373	.0004	.0005	
		b	.1633	.1264	.1628	.0374			
50,000	0	14,006,000	a	.1644	.1224	.1640	.0416	.0004	.0005
			b	.1633	.1214	.1628	.0414		
	1,000	14,001,000	a	.1645	.1223	.1638	.0415	.0007	.0005
			b	.1633	.1212	.1628	.0416		
	9,000	14,010,000	a	.1644	.1223	.1638	.0415	.0006	.0007
			b	.1634	.1211	.1627	.0416		
	90,000	14,100,000	a	.1648	.1220	.1637	.0417	.0011	.0013
			b	.1637	.1209	.1624	.0415		
	1,351,830	15,451,830	-----				-----		Bar ruptured at south edge of north middle bearing.

No. 337.

Marks, 7×2, 6.

Turned down from bar 1½" diameter. 0.25 per cent carbon. Oil tempered and annealed at low heat.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.			
Pounds. 45,000	0	0	a	Inch. .1645	.1270	.1638	Inch. .0868	.0007	
			b	.1642	.1268	.1636	.0868	.0006	
	1,000	1,000	a	.1645	.1267	.1638	.0871	.0007	
			b	.1642	.1262	.1635	.0873	.0007	
	9,000	10,000	a	.1647	.1263	.1638	.0875	.0009	
			b	.1643	.1262	.1634	.0872	.0009	
	90,000	100,000	a	.1646	.1260	.1634	.0874	.0012	
			b	.1645	.1258	.1634	.0876	.0011	
	9,900,000	10,000,000	a	.1644	.1258	.1637	.0879	.0007	
			b	.1640	.1254	.1633	.0879	.0007	
10,000	10,010,000	-----							

50,000	0	10,010,000	a	.1648	.1215	.1635	.0420	.0013	
			b	.1644	.1212	.1631	.0419	.0013	
90,000	10,100,000	a	.1650	.1216	.1635	.0419	.0015		
		b	.1648	.1213	.1630	.0417	.0018		
3,655,660	13,755,660	-----							
Bar ruptured at the north edge of south middle bearing.									

No. 338.

Marks, N3-C.

0.17 per cent carbon; 3.25 per cent nickel. Metal in natural state the ingot.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maxim um fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.			De- fec- tions.	Sets.	Remarks.
	Successive.	Total.	On line.	Un- load- ed.	Load- ed.			
Pounds. 10,000	0	0	a	.1643	.1558	.1643	.0085	0. 0.
			b	.1643	.1559	.1643	.0084	
	1,000	1,000	a	.1644	.1559	.1643	.0084	.0001
			b	.1642	.1559	.1643	.0084	-.0001
	9,000	10,000	a	.1642	.1558	.1642	.0084	0.
			b	.1643	.1558	.1642	.0084	.0001
15,000	0	10,000	a	.1644	.1517	.1643	.0126	.0001
			b	.1643	.1518	.1643	.0125	0.
	11,000	21,000	a	.1643	.1518	.1643	.0125	0.
			b	.1643	.1519	.1643	.0124	0.
20,000	0	21,000	a	.1642	.1475	.1641	.0166	.0001
			b	.1640	.1475	.1640	.0165	0.
	11,000	32,000	a	.1642	.1475	.1641	.0166	.0001
			b	.1641	.1474	.1642	.0168	-.0001
25,000	0	32,000	a	.1643	.1433	.1642	.0209	.0001
			b	.1642	.1433	.1642	.0209	0.
	11,000	43,000	a	.1642	.1431	.1642	.0211	0.
			b	.1642	.1432	.1642	.0210	0.
30,000	0	43,000	a	.1646	.1392	.1641	.0249	.0005
			b	.1644	.1389	.1639	.0250	.0005
	1,000	44,000	a	.1645	.1391	.1642	.0251	.0003
			b	.1643	.1388	.1640	.0252	.0003
	10,000	54,000	a	.1644	.1389	.1640	.0251	.0004
			b	.1644	.1387	.1640	.0253	.0004
185,050	239,050	-----	-----	-----	-----	-----	-----	Bar ruptured .20 north of the north edge of south middle bearing.

No. 339.

Marks, $7 \times 2, 7$.Turned down from bar $1\frac{1}{4}$ " diameter. 0.25 per cent carbon. Oil tempered and annealed at high heat.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotation.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.			
Pounds. 50,000	0	0	a	<i>Inch.</i> .1626	<i>Inch.</i> .1216	<i>Inch.</i> .1624	<i>Inch.</i> .0408	<i>Inch.</i> .0002	
			b	.1626	.1218	.1625	.0407	.0001	
	1,000	1,000	a	.1623	.1215	.1622	.0407	.0001	
			b	.1627	.1216	.1624	.0408	.0008	
	9,000	10,000	a	.1624	.1213	.1623	.0410	.0001	
			b	.1627	.1213	.1624	.0411	.0008	
125,000	135,000	a	.1626	.1212	.1624	.0412	.0002		
		b	.1627	.1214	.1625	.0411	.0002		
12,865,000	13,000,000	a	.1627	.1210	.1623	.0413	.0004		
		b	.1629	.1213	.1626	.0413	.0008		
55,000	0	13,000,000	a	.1626	.1169	.1623	.0454	.0008	
			b	.1629	.1174	.1627	.0453	.0002	
	1,000	13,001,000	a	.1625	.1167	.1623	.0456	.0002	
			b	.1628	.1173	.1626	.0453	.0002	
	9,000	13,010,000	a	.1625	.1165	.1621	.0456	.0004	
			b	.1629	.1170	.1625	.0455	.0004	
	90,000	13,100,000	a	.1622	.1165	.1618	.0453	.0004	
			b	.1628	.1170	.1625	.0455	.0008	
	100,000	13,200,000	a	.1625	.1164	.1620	.0456	.0005	
			b	.1628	.1170	.1625	.0455	.0003	
563,610	13,763,610	.....	.....	.....	.....	.....	.....	Bar ruptured 1" north of the north edge of north middle bearing.

No. 340.

Marks, 7×2, 8.
 Turned down from bar 1½" diameter. 0.25 per cent carbon. Oil tempered and annealed at high heat.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maxim- um fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Def- lec- tions.	Sets.	Remarks.		
	Successive.	Total.	On line.	Un- load- ed.	Load- ed.	Un- load- ed.					
Pounds. 50,000	0	0	a b	Inch. .1640 .1640	Inch. .1226 .1224	Inch. .1639 .1637	Inch. .0413 .0413	Inch. .0001 .0008			
	1,000	1,000	a b	.1638 .1638	.1222 .1224	.1637 .1635	.0415 .0411	.0001 .0008			
	9,000	10,000	a b	.1643 .1639	.1226 .1225	.1640 .1636	.0414 .0411	.0008 .0008			
	113,000	123,000	a b	.1645 .1640	.1226 .1224	.1642 .1637	.0416 .0413	.0008 .0008			
	15,878,930	16,001,930	a b	.1641 .1640	.1227 .1224	.1641 .1639	.0414 .0415	0. .0001			
	55,000	0	16,001,930	a b	.1645 .1640	.1187 .1182	.1643 .1638	.0456 .0456	.0002 .0002		
		11,000	16,012,930	a b	.1642 .1641	.1183 .1180	.1643 .1638	.0460 .0458	-.0001 .0003		
		100,000	16,112,930	a b	.1640 .1640	.1182 .1182	.1640 .1638	.0458 .0456	0. .0002		
		2,887,070	19,000,000	a b	.1640 .1642	.1185 .1180	.1643 .1638	.0458 .0458	-.0008 .0004		
		60,000	0	19,000,000	a b	.1645 .1637	.1145 .1140	.1640 .1636	.0495 .0496	.0005 .0001	
			1,000	19,001,000	a b	.1640 .1640	.1145 .1141	.1640 .1638	.0495 .0497	0. .0002	
	9,000		19,010,000	a b	.1640 .1639	.1143 .1140	.1640 .1638	.0497 .0498	0. .0001		
90,000	19,100,000		a b	.1643 .1640	.1140 .1140	.1640 .1637	.0600 .0497	.0003 .0008			
13,865,120	32,965,120								Bar ruptured about mid- way between middle bearings.		

No. 341.

Marks, $7 \times 2, 4$.Turned down from bar $1\frac{1}{4}$ " diameter. 0.25 per cent carbon. Annealed at high heat.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
Pounds. 50,000	0	0	a	.1656	.1211	.1621	.0410	.0085		
			b	.1659	.1213	.1621	.0408	.0088		
	1,000	1,000	a	.1660	.1198	.1614	.0416	.0046		
			b	.1667	.1208	.1619	.0416	.0048		
	9,000	10,000	a	.1662	.1210	.1623	.0413	.0089		
			b	.1657	.1202	.1618	.0416	.0089		
	95,000	105,000	a	.1661	.1202	.1620	.0418	.0041		
			b	.1657	.1194	.1615	.0421	.0042		
	157,790	262,790	-----				-----			
			Bar ruptured $1^{\circ}.40$ north of the north edge of south middle bearing.							

No. 342.

Marks, $7 \times 2, 10$.Turned down from bar $1\frac{1}{4}$ " diameter. 0.25 per cent carbon. Hardened.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
Pounds. 50,000	0	0	a	.1634	.1216	.1634	.0418	0.		
			b	.1629	.1224	.1628	.0404	.0001		
	1,000	1,000	a	.1633	.1214	.1633	.0419	0.		
			b	.1628	.1210	.1628	.0418	0.		
	9,000	10,000	a	.1632	.1215	.1633	.0418	-.0001		
			b	.1628	.1210	.1627	.0417	.0001		
	110,000	120,000	a	.1631	.1215	.1632	.0417	-.0001		
			b	.1629	.1222	.1628	.0406	.0001		
	2,332,950	2,952,950	-----				-----			
			Bar ruptured $^{\circ}.30$ south of the south edge of north middle bearing.							

No. 848.

Marks, C 3-B.

0.20 per cent carbon. Heated low cherry and quenched in oil.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10'.

Maxi- mum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				De- fec- tions.	Sets.	Remarks.
	Successive.	Total.	On line.	Un- load- ed.	Load- ed.	Un- load- ed.			
Pounds. 20,000	0	0	a	.1630	.1469	.1630	.0161	0.	
			b	.1648	.1480	.1648	.0168	0.	
	1,000	1,000	a	.1688	.1470	.1682	.0162	.0001	
			b	.1641	.1481	.1642	.0161	-.0001	
	9,000	10,000	a	.1682	.1470	.1682	.0162	0.	
			b	.1642	.1481	.1642	.0161	0.	
25,000	0	10,000	a	.1688	.1482	.1682	.0200	.0001	
			b	.1642	.1440	.1640	.0200	.0002	
	1,000	11,000	a	.1682	.1482	.1688	.0201	-.0001	
			b	.1642	.1488	.1641	.0208	-.0001	
	9,000	20,000	a	.1682	.1429	.1682	.0208	0.	
			b	.1642	.1440	.1640	.0200	-.0002	
30,000	0	20,000	a	.1684	.1898	.1688	.0240	.0001	
			b	.1642	.1898	.1640	.0242	.0002	
	1,000	21,000	a	.1684	.1890	.1682	.0242	.0002	
			b	.1641	.1898	.1640	.0242	.0001	
	9,000	30,000	a	.1682	.1888	.1681	.0248	.0001	
			b	.1642	.1897	.1640	.0248	.0002	
	80,000	110,000	a	.1688	.1888	.1681	.0248	.0004	
			b	.1648	.1897	.1640	.0248	.0008	
	4,020,000	4,180,000	a	.1688	.1888	.1681	.0248	.0004	
			b	.1648	.1897	.1640	.0248	.0008	
	1,000,000	5,180,000	a	.1684	.1890	.1682	.0242	.0002	
			b	.1648	.1898	.1640	.0242	.0008	
	1,000,000	6,180,000	a	.1688	.1888	.1680	.0242	.0005	
			b	.1644	.1897	.1640	.0248	.0004	
	87,000	7,000,000	a	.1688	.1889	.1680	.0241	.0008	
			b	.1648	.1896	.1640	.0242	.0008	
35,000	0	7,000,000	a	.1688	.1847	.1680	.0288	.0005	
			b	.1644	.1855	.1689	.0284	.0005	
	1,000	7,001,000	a	.1687	.1846	.1680	.0284	.0007	
			b	.1645	.1855	.1688	.0288	.0007	
	9,000	7,010,000	a	.1686	.1845	.1628	.0288	.0008	
			b	.1646	.1855	.1688	.0288	.0008	
	240,000	7,250,000	a	.1640	.1842	.1625	.0288	.0015	
			b	.1650	.1849	.1685	.0286	.0015	
	487,990	7,737,990	.....	.....	.....	.....	.....	.....	Bar ruptured 1" south of the south edge of north middle bearing.

Steel rail head No. 40.

Cammell toughened steel, 1872.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maxi- mum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				De- flec- tions.	Sets.	Remar'
	Successive.	Total.	On line.	Un- load- ed.	Load- ed.	Un- load- ed.			
<i>Pounds.</i> 80,000	10,000	10,000	a b	.1628 .1646	.1886 .1402	.1626 .1645	.0240 .0243	.0002 .0001	
35,000	0	10,000	a b	.1628 .1645	.1344 .1360	.1625 .1644	.0281 .0284	.0008 .0001	
	1,000	11,000	a b	.1627 .1648	.1340 .1362	.1622 .1644	.0282 .0282	.0005 .0004	
	9,000	20,000	a b	.1627 .1651	.1340 .1362	.1622 .1646	.0282 .0284	.0005 .0005	
	80,000	100,000	a b	.1628 .1649	.1340 .1364	.1622 .1648	.0282 .0284	.0001 .0001	
	100,000	200,000	a b	.1627 .1647	.1344 .1362	.1626 .1645	.0282 .0283	.0001 .0002	
40,000	0	200,000	a b	.1628 .1647	.1305 .1325	.1625 .1645	.0320 .0320	.0008 .0002	
	1,000	201,000	a b	.1626 .1647	.1303 .1320	.1623 .1645	.0320 .0325	.0008 .0002	
	9,000	210,000	a b	.1628 .1648	.1302 .1320	.1624 .1648	.0322 .0323	.0004 .0005	
	90,000	300,000	a b	.1633 .1640	.1307 .1315	.1628 .1637	.0321 .0322	.0005 .0008	
	3,358,520	3,658,520	.....	.....	.....	.....	.....	.....	Bar ruptured 1".40 south of the south edge of north middle bear- ing.

No. 345.

Steel rail head No. 41.

Cammell toughened steel, 1872.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.			
Pounds. 40,000	0	0	a	Inch. .1653	Inch. .1229	Inch. .1652	Inch. .0323		
			b	.1624	.1238	.1614	.0321			.0010
	10,000	10,000	a	.1673	.1340	.1665	.0325		
			b	.1610	.1280	.1602	.0322			.0008
	90,000	100,000	a	.1679	.1348	.1673	.0325		
			b	.1605	.1278	.1600	.0322			.0005
	586,430	636,430	.....	.....	.....	.....	.....		Bar ruptured at north edge of north middle bearing.

Barrow steel, 1873.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.			
Pounds. 40,000	0	0	a	.1649	.1826	.1648	.0822	.0001	
			b	.1622	.1800	.1621	.0821	.0001	
	1,000	1,000	a	.1650	.1826	.1648	.0822	.0002	
			b	.1623	.1802	.1623	.0821	0.	
	9,000	10,000	a	.1648	.1820	.1646	.0826	.0002	
			b	.1623	.1800	.1621	.0821	.0002	
	90,000	100,000	a	.1648	.1822	.1647	.0825	.0001	
			b	.1624	.1800	.1623	.0823	.0001	
	32,900,000	33,000,000	a	.1649	.1824	.1650	.0826	-.0001	
			b	.1625	.1800	.1625	.0825	0.	
45,000	0	33,000,000	a	.1650	.1287	.1650	.0863	0.	
			b	.1627	.1263	.1625	.0862	-.0002	
	1,000	33,001,000	a	.1650	.1285	.1649	.0864	.0001	
			b	.1627	.1262	.1625	.0863	.0002	
	9,000	33,010,000	a	.1647	.1288	.1648	.0865	-.0001	
			b	.1625	.1260	.1624	.0864	+.0001	
	90,000	33,100,000	a	.1649	.1284	.1649	.0865	0.	
			b	.1625	.1260	.1624	.0864	.0001	
	7,140,000	40,240,000	a	.1553	.1189	.1552	.0863	.0001	
			b	.1589	.1164	.1528	.0864	.0011	
50,000	0	40,240,000	a	.1555	.1147	.1552	.0406	.0008	
			b	.1580	.1124	.1528	.0404	.0002	
	1,000	40,241,000	a	.1553	.1149	.1552	.0408	.0001	
			b	.1528	.1123	.1528	.0406	0.	
	10,000	40,251,000	a	.1553	.1145	.1551	.0406	.0002	
			b	.1528	.1117	.1525	.0408	.0008	
	100,000	40,351,000	a	.1555	.1145	.1552	.0407	.0008	
			b	.1528	.1117	.1525	.0408	.0008	
2,176,670	42,527,670		.....	.....	.....	.....	.....	Bar ruptured in the south middle bearing.	

No. 347.

Steel rail head No. 47.

John Brown & Co., Sheffield Atlas steel.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
<i>Pounds.</i> 40,000	0	0	a b	<i>Inch.</i> .1620 .1685	<i>Inch.</i> .1800 .1817	<i>Inch.</i> .1618 .1685	<i>Inch.</i> .0818 .0818	<i>Inch.</i> .0002 0.		
	1,000	1,000	a b	.1620 .1686	.1297 .1813	.1618 .1634	.0821 .0821	.0002 .0002		
	9,000	10,000	a b	.1620 .1687	.1298 .1816	.1618 .1685	.0820 .0819	.0002 .0002		
	90,000	100,000	a b	.1619 .1685	.1299 .1813	.1618 .1685	.0819 .0822	.0001 0.		
	3,149,000	3,249,000	-----							
										Bar ruptured .65 north of the north edge of south middle bearing.

No. 348.

Steel rail head No. 49.

Petim Gaudet.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
<i>Pounds.</i> 40,000	0	0	a b	<i>Inch.</i> .1687 .1680	<i>Inch.</i> .1818 .1808	<i>Inch.</i> .1686 .1680	<i>Inch.</i> .0823 .0822	<i>Inch.</i> .0001 0.		
	1,000	1,000	a b	.1687 .1688	.1305 .1306	.1627 .1629	.0822 .0823	.0010 .0009		
	2,600	3,600	a b	.1684 .1640	.1305 .1310	.1628 .1635	.0823 .0825	.0006 .0006		
	96,400	100,000	a b	.1623 .1644	.1295 .1813	.1623 .1642	.0823 .0829	0. .0002		
	718,830	818,880	-----							
										Bar ruptured 1" north of the north edge of south middle bearing.

No. 349.

Steel rail head No. 51.

Landore Siemens steel, 11.73.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a b	Inch. .1680 .1665	Inch. .1287 .1822	Inch. .1806 .1845	Inch. .0819 .0828	Inch. .0024 .0020		
	1,000	1,000	a b	.1626 .1673	.1278 .1822	.1599 .1648	.0826 .0826	.0027 .0025		
	9,000	10,000	a b	.1594 .1677	.1268 .1822	.1593 .1649	.0825 .0827	.0001 .0028		
	90,000	100,000	a b	.1624 .1677	.1268 .1818	.1594 .1647	.0826 .0829	.0080 .0080		
	424,760	524,760	-----							Bar ruptured 2" north of the north edge of north middle bearing.

No. 350.

Marks, C 5-A.

0.20 per cent carbon. Heated white hot and quenched in brine.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a b	Inch. .1680 .1628	Inch. .1810 .1807	Inch. .1628 .1627	Inch. .0818 .0820	Inch. .0002 .0001		
	1,000	1,000	a b	.1627 .1680	.1806 .1808	.1627 .1680	.0821 .0822	0. 0.		
	9,000	10,000	a b	.1627 .1680	.1806 .1808	.1627 .1680	.0822 .0822	0. 0.		
	90,000	100,000	a b	.1626 .1680	.1802 .1806	.1626 .1629	.0824 .0824	0. .0001		
	463,910	563,910	-----							Bar ruptured 1."80 north of the north edge of north middle bearing.

No. 351.

Steel rail head No. 52.

Wilson Cammell Dowlais steel, 10.70 guaranteed.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.			Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.				Un-load-ed.
<i>Pounds.</i> 40,000	0	0	a b	<i>Inch.</i> .1650 .1644	<i>Inch.</i> .1319 .1314	<i>Inch.</i> .1648 .1648	<i>Inch.</i> .0329 .0239	<i>Inch.</i> .0002 .0001	
	1,000	1,000	a b	.1647 .1648	.1312 .1317	.1641 .1644	.0329 .0327	.0006 .0004	
	9,000	10,000	a b	.1632 .1660	.1305 .1328	.1632 .1658	.0327 .0330	0. .0002	
	90,000	100,000	a b	.1637 .1659	.1307 .1327	.1635 .1657	.0328 .0330	.0002 .0002	
	2,907,310	2,907,310	.....	.....	.....	.....	.....	.....	Bar ruptured ".10 north of the north edge of south middle bearing, or between the middle bearings, at a point ".125 from the circumference of the bar, and at about right angles with the top of the rail.

Marks, C 5-D.
 0.20 per cent carbon. Heated bright yellow and quenched in oil.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.			
Pounds 40,000	0	0	a	<i>Inch.</i> .1682	<i>Inch.</i> .1312	<i>Inch.</i> .1682	<i>Inch.</i> .0320	0.	
			b	.1689	.1313	.1685	.0322			.0004
	1,000	1,000	a	.1630	.1306	.1629	.0321	.0001	
			b	.1641	.1317	.1637	.0320	.0004	
	9,000	10,000	a	.1626	.1314	.1627	.0318	.0001	
			b	.1644	.1315	.1636	.0321	.0008	
	90,000	100,000	a	.1633	.1293	.1622	.0329	.0011	
			b	.1650	.1307	.1635	.0328	.0015	
	118,980	118,980	.....	.....	.....	.....	.....	Bar ruptured .50 south of the south edge of north middle bearing, or between the middle bearings.

No. 353.

Marks, C 5-C.
 0.20 per cent carbon. Heated bright yellow, quenched in oil, and annealed at 1,000° F.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.			
Pounds 40,000	0	0	a	<i>Inch.</i> .1635	<i>Inch.</i> .1315	<i>Inch.</i> .1635	<i>Inch.</i> .0320	0.	
			b	.1637	.1293	.1610	.0317			.0027
	1,000	1,000	a	.1659	.1328	.1650	.0322	.0009	
			b	.1618	.1289	.1609	.0320	.0009	
	9,000	10,000	a	.1676	.1327	.1652	.0325	.0024	
			b	.1618	.1271	.1595	.0324	.0028	
	78,480	88,480	.....	.....	.....	.....	.....	Bar ruptured at south edge of north middle bearing.

No. 354.

Marks, C 5-D.

0.20 per cent carbon. Heated bright yellow and cooled in sand.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a	Inch. .1629	Inch. .1270	Inch. .1620	Inch. .0850	Inch. .0009		
			b	.1648	.1265	.1608	.0848			.0040
	1,000	1,000	a	.1279	.0917	.1257	.0840	.0022		
			b	.2268	.1280	.1627	.0847	.0081		
	7,820	8,820	-----				-----			
Bar ruptured at south edge of north middle bearing.										

No. 355.

Marks, N 5-A.

0.17 per cent carbon; 3.25 per cent nickel. Heated white hot and quenched in brine.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a	Inch. .1631	Inch. .1292	Inch. .1630	Inch. .0838	Inch. .0001		
			b	.1628	.1290	.1627	.0837			.0001
	1,000	1,000	a	.1630	.1292	.1630	.0838	0.		
			b	.1628	.1290	.1627	.0837	.0001		
	9,000	10,000	a	.1632	.1290	.1630	.0840	.0002		
			b	.1625	.1278	.1625	.0847	0.		
	30,880	40,880	-----				-----			
	Bar ruptured at the south edge of south middle bearing, at a smooth spot .020 x .015 at circumference of bar. Defective specimen.									

No. 356.

Marks, N 5-B.

0.17 per cent carbon; 3.25 per cent nickel. Heated bright yellow and quenched in oil.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a	<i>Inch.</i> .1685	<i>Inch.</i> .1260	<i>Inch.</i> .1592	<i>Inch.</i> .0332	<i>Inch.</i> .0048		
			b	.1664	.1818	.1647	.0329	.0017		
	1,000	1,000	a	.1620	.1265	.1618	.0333	.0002		
			b	.1647	.1812	.1645	.0333	.0002		
	9,000	10,000	a	.1620	.1233	.1619	.0336	.0001		
			b	.1646	.1810	.1645	.0335	.0001		
	88,430	98,430	-----				-----	-----		Bar ruptured .75 north of the north edge of south middle bearing, at three smooth spots. Defective specimen.

No. 357.

Marks, N 5-C.

0.17 per cent carbon; 3.25 per cent nickel. Heated bright yellow, quenched in oil, and annealed at 1,000° F.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a	<i>Inch.</i> .1635	<i>Inch.</i> .1290	<i>Inch.</i> .1620	<i>Inch.</i> .0330	<i>Inch.</i> .0015		
			b	.1649	.1808	.1644	.0336	.0005		
	1,000	1,000	a	.1612	.1277	.1612	.0335	0.		
			b	.1658	.1814	.1653	.0339	.0005		
	9,000	10,000	a	.1610	.1263	.1605	.0342	.0005		
			b	.1664	.1814	.1655	.0341	.0009		
	9,960	19,960	-----				-----	-----		Bar ruptured .90 north of the north edge of north middle bearing, at a smooth spot .75 x .30. Defective specimen.

No. 358.

Marks, N 5-D.

0.17 per cent carbon; 3.25 per cent nickel. Heated bright yellow and cooled in sand.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a	Inch. .1645	Inch. .1210	Inch. .1642	Inch. .0832	Inch. .0003	Bar ruptured 1".50 north of the north edge of south middle bearing, at a smooth spot ".25 x ".10 at the circumference of the bar.	
			b	.1648	.1312	.1648	.0831	.0005		
	1,000	1,000	a	.1683	.1296	.1623	.0830	.0005		
			b	.1660	.1306	.1686	.0831	.0024		
	9,000	10,000	a	.1685	.1296	.1629	.0833	.0006		
			b	.1660	.1308	.1636	.0838	.0024		
	33,110	48,110	-----				-----	-----		

No. 359.

Marks, C 3-C.

0.20 per cent carbon. Heated bright red and quenched in oil.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a	Inch. .1639	Inch. .1314	Inch. .1635	Inch. .0821	Inch. .0004	Bar ruptured 2" north of the north edge of north middle bearing, at a blowhole ".15 diameter near the circumference of bar.	
			b	.1648	.1316	.1638	.0822	.0006		
	1,000	1,000	a	.1630	.1307	.1630	.0823	0.		
			b	.1647	.1320	.1640	.0820	.0007		
	9,000	10,000	a	.1620	.1298	.1619	.0826	.0001		
			b	.1665	.1313	.1639	.0826	.0016		
	90,000	100,000	a	.1649	.1280	.1610	.0830	.0039		
			b	.1660	.1290	.1627	.0837	.0038		
	3,860	108,860	-----				-----	-----		

0.17 per cent carbon; 3.25 per cent nickel. Heated low cherry and quenched in oil.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
<i>Pounds.</i> 40,000	0	0	a	<i>Inch.</i> .1638	<i>Inch.</i> .1287	<i>Inch.</i> .1620	<i>Inch.</i> .0833	<i>Inch.</i> .0018		
			b	.1665	.1314	.1647	.0833	.0018		
	1,000	1,000	a	.1640	.1302	.1637	.0835	.0008		
			b	.1648	.1310	.1645	.0835	.0008		
	9,000	10,000	a	.1637	.1300	.1636	.0836	.0001		
			b	.1649	.1310	.1645	.0835	.0004		
	2,900	22,900		Bar ruptured 5".75 south of the south edge of south middle bearing, at a series of smooth spots or streaks running across the bar. Defective specimen.

No. 361.

Steel rail No. 56.

28 P. S. Co. 85.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
<i>Pounds.</i> 40,000	0	0	a	<i>Inch.</i> .1635	<i>Inch.</i> .1309	<i>Inch.</i> .1634	<i>Inch.</i> .0825	<i>Inch.</i> .0001		
			b	.1635	.1315	.1635	.0820	0.		
	1,000	1,000	a	.1635	.1309	.1635	.0826	0.		
			b	.1636	.1314	.1634	.0820	.0002		
	9,000	10,000	a	.1636	.1307	.1635	.0828	.0001		
			b	.1636	.1306	.1633	.0827	.0003		
	90,000	100,000	a	.1685	.1305	.1634	.0829	.0001		
			b	.1685	.1304	.1631	.0827	.0004		
	3,668,360	3,768,360		Bar ruptured in south middle bearing, about the middle of the bearing.

No. 362.

Steel rail No. 60.
 Cammell Sheffield toughened steel, 1873.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.			
Pounds. 40,000	0	0	a	Inch. .1630	Inch. .1308	Inch. .1623	Inch. .0820	Inch. .0002	
			b	.1644	.1324	.1642	.0818	.0002	
	1,000	1,000	a	.1615	.1293	.1614	.0821	.0001	
			b	.1646	.1325	.1646	.0821	0.	
	9,000	10,000	a	.1623	.1297	.1620	.0823	.0008	
			b	.1649	.1325	.1647	.0822	.0002	
	90,000	100,000	a	.1626	.1296	.1620	.0824	.0006	
			b	.1653	.1326	.1648	.0822	.0005	
3,724,840	3,824,840	.....				.....	.....	Bar ruptured in the north middle bearing.

No. 363.

Steel rail No. 62.
 Landore Siemens. 2-72.
 Diameter 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a	Inch. .1639	Inch. .1293	Inch. .1613	Inch. .0820	Inch. .0023		
			b	.1657	.1300	.1621	.0821	.0036		
	1,000	1,000	a	.1657	.1183	.1513	.0835	.0039		
			b	.1747	.1252	.1583	.0836	.0059		
	9,000	10,000	a	.1605	.1290	.1608	.0813	.0002		
			b	.1634	.1200	.1526	.0826	.0108		
	41,100	51,100		Bar run hot. Stream of water played on it after the first 11,000 rotations. Bar ruptured .70 north of the north edge of south middle bearing.

No. 365.

Marks 7×3, 1.

Turned down from bar 1½" diameter. 0.29 per cent carbon. Annealed at low heat.

Diameter 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 50,000	0	0	a b	Inch. .1642 .1640	Inch. .1210 .1213	Inch. .1640 .1638	Inch. .0430 .0426	Inch. .0002 .0002		
	1,000	1,000	a b	.1640 .1640	.1213 .1210	.1640 .1638	.0427 .0426	0. .0002		
	9,000	10,000	a b	.1640 .1640	.1212 .1213	.1640 .1638	.0428 .0426	0. .0002		
	115,000	125,000	a b	.1640 .1640	.1213 .1217	.1640 .1640	.0427 .0423	0. 0.		
	20,875,000	21,000,000	a b	.1643 .1642	.1211 .1213	.1642 .1640	.0431 .0427	.0001 .0002		
	55,000	0	21,000,000	a b	.1642 .1641	.1172 .1175	.1642 .1640	.0470 .0465	0. .0001	
		1,000	21,001,000	a b	.1643 .1642	.1173 .1175	.1642 .1640	.0469 .0465	.0001 .0002	
		9,000	21,010,000	a b	.1643 .1641	.1177 .1175	.1642 .1640	.0465 .0465	.0001 .0001	
		90,000	21,100,000	a b	.1642 .1641	.1174 .1175	.1642 .1640	.0463 .0465	0. .0001	
		5,900,000	27,000,000	a b	.1644 .1640	.1173 .1170	.1640 .1640	.0467 .0470	.0004 0.	
60,000		0	27,000,000	a b	.1643 .1641	.1135 .1140	.1640 .1639	.0506 .0499	.0008 .0002	
	1,000	27,001,000	a b	.1643 .1639	.1135 .1138	.1642 .1640	.0507 .0502	+ .0001 - .0001		
	9,000	27,010,000	a b	.1642 .1640	.1140 .1140	.1643 .1640	.0508 .0500	- .0001 0.		
	107,610	27,117,610	a b	.1642 .1642	.1137 .1137	.1641 .1640	.0504 .0506	.0001 .0002		
	862,340	27,970,450	.....	.....	.....	.....	.....	.....	Bar ruptured in the south middle bearing. The south end bearing was reduced to ".84 diameter from wear.

No. 366.

Marks, 7×3, 2.

Turned down from bar 1½" diameter. 0.29 per cent carbon. Annealed at low heat.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.			
Pounds. 50,000	0	0	a	.1646	.1226	.1645	.0419	.0001	
			b	.1644	.1225	.1648	.0418	.0001	
	1,000	1,000	a	.1645	.1221	.1643	.0422	.0002	
			b	.1643	.1219	.1643	.0424	0.	
	9,000	10,000	a	.1645	.1220	.1644	.0424	.0001	
			b	.1644	.1220	.1643	.0423	.0001	
	91,000	101,000	a	.1645	.1220	.1645	.0425	0.	
			b	.1644	.1218	.1643	.0425	.0001	
	20,899,000	21,000,000	a	.1646	.1217	.1645	.0428	.0001	
			b	.1644	.1217	.1643	.0426	.0001	
55,000	0	21,000,000	a	.1647	.1179	.1645	.0466	.0002	
			b	.1645	.1177	.1645	.0468	0.	
	1,000	21,001,000	a	.1646	.1180	.1645	.0465	+ .0001	
			b	.1644	.1178	.1645	.0467	- .0001	
	9,000	21,010,000	a	.1646	.1178	.1645	.0467	.0001	
			b	.1644	.1178	.1644	.0466	0.	
	90,000	21,100,000	a	.1645	.1177	.1645	.0468	0.	
			b	.1645	.1176	.1644	.0468	.0001	
	5,908,960	27,008,960	a	.1644	.1180	.1644	.0464	0.	
			b	.1645	.1179	.1644	.0465	.0001	
60,000	0	27,008,960	a	.1647	.1143	.1646	.0508	+ .0001	
			b	.1646	.1147	.1647	.0500	- .0001	
	1,000	27,004,960	a	.1645	.1142	.1643	.0501	.0002	
			b	.1645	.1141	.1644	.0503	.0001	
	9,000	27,018,960	a	.1644	.1137	.1644	.0507	0.	
			b	.1645	.1137	.1644	.0507	.0001	
	90,000	27,103,960	a	.1644	.1137	.1645	.0508	- .0001	
			b	.1645	.1138	.1644	.0506	+ .0001	
	439,200	27,543,160							Bar ruptured at north edge of south middle bearing. South end bearing reduced to .96 diameter from wear.

No. 367.

Marks, D.

Burden's best iron. Natural state.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.			
Pounds. 20,000	0	0	a	Inch. .1648	Inch. .1485	Inch. .1648	Inch. .0168	0.	.0001
			b	.1650	.1486	.1649	.0164		
	1,000	1,000	a	.1647	.1483	.1647	.0164	0.	.0001
			b	.1650	.1487	.1649	.0162		
	9,000	10,000	a	.1649	.1483	.1647	.0164	0.	.0002
			b	.1651	.1486	.1648	.0162		
25,000	0	10,000	a	.1649	.1444	.1645	.0201	.0004	.0006
			b	.1653	.1444	.1647	.0208		
	1,000	11,000	a	.1660	.1431	.1635	.0204	.0025	.0023
			b	.1660	.1431	.1637	.0206		
	89,000	100,000	a	.1649	.1442	.1643	.0201	.0006	.0009
			b	.1658	.1440	.1644	.0204		
	900,000	1,000,000	a	.1660	.1428	.1637	.0209	.0023	.0022
			b	.1660	.1429	.1638	.0209		
	1,716,380	2,716,380	.....	.....	.....	.....	.....	Bar ruptured .70 south of the south edge of north middle bearing.	

No. 368.

Marks, A.

Burden's best iron. Twisted 2 turns in length of 45".

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.			
Pounds. 25,000	0	0	a	Inch. .1640	Inch. .1433	Inch. .1640	Inch. .0207	0.	.0002
			b	.1645	.1437	.1643	.0206		
	1,000	1,000	a	.1639	.1433	.1639	.0201	0.	0.
			b	.1644	.1433	.1644	.0206		
	9,000	10,000	a	.1639	.1435	.1639	.0204	0.	0.
			b	.1644	.1433	.1644	.0206		
	90,000	100,000	a	.1639	.1435	.1640	.0205	-.0001	+.0001
			b	.1645	.1433	.1644	.0206		
	2,982,130	3,032,130	.....	.....	.....	.....	.....	Bar ruptured in the north middle bearing.	

No. 371.

Marks, 17 C.

Gautier steel bar. 0.17 per cent carbon. Hot rolled bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
<i>Pounds.</i> 60,000	0	0	a	<i>Inch.</i> .1650	<i>Inch.</i> .1170	<i>Inch.</i> .1646	<i>Inch.</i> .0476	<i>Inch.</i> .0004	Bar ruptured 1" north of the north edge of south middle bearing. Bar run hot and stream of water was played on it during test.	
			b	.1662	.1170	.1646	.0476	.0007		
	660	660	a	.1245	.0725	.1208	.0488	.0087		
			b	.2080	.1160	.1653	.0508	.0427		
	5,810	6,470	-----							

No. 372.

Marks, 17 C.

Gautier steel bar. 0.17 per cent carbon. Hot rolled bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
<i>Pounds.</i> 50,000	0	0	a	<i>Inch.</i> .1644	<i>Inch.</i> .1248	<i>Inch.</i> .1641	<i>Inch.</i> .0898	<i>Inch.</i> .0008	Bar ruptured midway between middle bearings. Bar run hot and stream of water played on it during test.	
			b	.1648	.1246	.1644	.0899	.0004		
	1,000	1,000	a	.1423	.0982	.1388	.0406	.0085		
			b	.1890	.1140	.1560	.0420	.0330		
	9,000	10,000	a	.1483	.0954	.1371	.0417	.0082		
			b	.1915	.1018	.1452	.0434	.0463		
	7,790	17,790	-----							

Marks, 17 C.
 Gautier steel bar. 0.17 per cent carbon. Hot rolled bar.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
Pounds. 45,000	0	0	a	Inch. .1645	Inch. .1280	Inch. .1648	Inch. .0863	Inch. .0002		
			b	.1658	.1286	.1648	.0862	.0005		
	1,000	1,000	a	.1575	.1195	.1565	.0870	.0010		
			b	.1727	.1280	.1604	.0874	.0128		
	9,000	10,000	a	.1820	.1200	.1577	.0877	.0248		
			b	.1710	.1140	.1570	.0480	.0140		
	60,400	70,400	-----				-----	-----		Bar ruptured 1" 10 south of south edge of north middle bearing. Bar run hot and stream of water played on it after the first 1,000 rotations.

No. 374.

Marks, 17 C.
 Gautier steel bar. 0.17 per cent carbon. Hot rolled bar.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
Pounds. 40,000	0	0	a	Inch. .1655	Inch. .1837	Inch. .1655	Inch. .0818	0. .0008		
			b	.1680	.1837	.1657	.0820			
	1,000	1,000	a	.1650	.1825	.1648	.0828	.0002		
			b	.1666	.1828	.1652	.0824	.0014		
	9,000	10,000	a	.1625	.1288	.1615	.0827	.0010		
			b	.1697	.1298	.1625	.0832	.0072		
	90,000	100,000	a	.1549	.1210	.1588	.0828	.0011		
			b	.1578	.1211	.1588	.0827	.0040		
	198,510	298,510	-----				-----	-----		Bar ruptured in south middle bearing. Bar run rather warm.

Gautier steel bar. 0.55 per cent carbon. Hot rolled bar.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.		
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.					
Pounds. 60,000	0	0	a	Inch. .1551	Inch. .1085	Inch. .1548	Inch. .0483	Inch. .0003			
			b	.1568	.1064	.1549	.0486			.0004	
	1,000	1,000	a	.1269	.0697	.1200	.0508	.0069			
			b	.1843	.0905	.1427	.0522	.0416			
	9,000	10,000	a	.1457	.0602	.1330	.0528	.0127			
			b	.1726	.0900	.1408	.0508	.0318			
	2,490	12,490	-----				-----	-----		-----	Bar ruptured .25 south of south edge of north middle bearing. Bar run hot and stream of water played on it after first 1,000 rotations.

No. 378.

Marks, 55 C.
 Gautier steel bar. 0.55 per cent carbon. Hot rolled bar.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.		
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.					
Pounds. 50,000	0	0	a	Inch. .1563	Inch. .1150	Inch. .1562	Inch. .0412	Inch. .0001			
			b	.1568	.1159	.1564	.0405			.0004	
	1,000	1,000	a	.1590	.1034	.1467	.0433	.0123			
			b	.1650	.1055	.1486	.0431	.0164			
	9,000	10,000	a	.1600	.1030	.1467	.0437	.0133			
			b	.1656	.1044	.1472	.0428	.0134			
	83,160	93,160	-----				-----	-----		-----	Bar ruptured in north middle bearing. Bar run hot and stream of water played on it after first 1,000 rotations.

No. 379.

Marks, 55 C.

Gautier steel bar. 0.55 per cent carbon. Hot rolled bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 45,000	0	0	a	.1567	.1200	.1565	.0865	.0002		
			b	.1570	.1202	.1568	.0866	.0002		
	1,000	1,000	a	.1546	.1162	.1536	.0874	.0010		
			b	.1597	.1169	.1546	.0877	.0061		
	9,000	10,000	a	.1512	.1120	.1503	.0883	.0009		
			b	.1628	.1140	.1526	.0886	.0102		
	90,000	100,000	a	.1547	.1130	.1520	.0891	.0027		
			b	.1616	.1138	.1527	.0889	.0089		
	66,240	166,240	-----							
										Bar ruptured in the south middle bearing. Bar run hot and stream of water played on it after first 1,000 rotations.

No. 380.

Marks, 55 C.

Gautier steel bar. 0.55 per cent carbon. Hot rolled bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds. 40,000	0	0	a	.1545	.1225	.1543	.0818	.0002		
			b	.1586	.1215	.1534	.0819	.0001		
	1,000	1,000	a	.1548	.1218	.1542	.0824	.0001		
			b	.1585	.1210	.1530	.0820	.0006		
	9,000	10,000	a	.1555	.1225	.1547	.0822	.0008		
			b	.1590	.1197	.1521	.0824	.0009		
	98,000	108,000	a	.1583	.1198	.1526	.0828	.0007		
			b	.1563	.1188	.1518	.0830	.0085		
	352,350	455,350	-----							
										Bar ruptured 1/4" south of the north edge of south middle bearing. Bar run hot and stream of water played on it after 10,000 rotations.

Gautier steel bar. 0.55 per cent carbon. Hot rolled bar.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
Pounds. 35,000	0	0	a	Inch. .1558	Inch. .1280	Inch. .1558	Inch. .0278	0.		
			b	.1560	.1281	.1559	.0278			
	1,000	1,000	a	.1559	.1280	.1558	.0278	.0001		
			b	.1559	.1280	.1558	.0278			
	9,000	10,000	a	.1556	.1275	.1556	.0281	0.		
			b	.1560	.1277	.1558	.0281			
	90,000	100,000	a	.1560	.1279	.1558	.0279	.0002		
			b	.1558	.1278	.1557	.0279			
	800,720	900,720	-----				-----	-----		Bar ruptured 1".60 north of north edge of north middle bearing, or between middle bearings. Bar run hot and stream of water played on it after 10,000 rotations.

No. 382.

Marks, 82 C.
 Gautier steel bar. 0.82 per cent carbon. Hot rolled bar.
 Diameter, 1". Speed of rotation, 500 per minute.
 Length between end supports, 33".
 Loaded over 4" length at middle.
 Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-loaded.				
Pounds. 60,000	0	0	a	Inch. .1556	Inch. .1075	Inch. .1555	Inch. .0480	.0001		
			b	.1560	.1072	.1557	.0485			
	1,000	1,000	a	.1457	.0958	.1452	.0494	.0005		
			b	.1609	.1010	.1515	.0505			
	9,000	10,000	a	.1533	.0957	.1471	.0514	.0062		
			b	.1630	.0956	.1477	.0521			
	17,250	37,250	-----				-----	-----		Bar ruptured 1".50 north of north edge of south middle bearing. Bar run hot and stream of water played on it after first 1,000 rotations.

No. 383.

Marks, 55 C.

Gautier steel bar. 0.55 per cent carbon. Hot rolled bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.	
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.				
Pounds 30,000	0	0	a	Inch. .1645	Inch. .1302	Inch. .1544	Inch. .0242	Inch. .0001		
			b	.1645	.1304	.1544	.0240	.0001		
1,000	1,000	a	.1543	.1301	.1543	.0242	0.			
		b	.1645	.1300	.1544	.0244	.0001			
9,000	10,000	a	.1543	.1301	.1543	.0242	0.			
		b	.1544	.1300	.1543	.0243	.0001			
90,000	100,000	a	.1544	.1300	.1543	.0243	.0001			
		b	.1544	.1300	.1543	.0243	.0001			
710,630	810,630	-----				-----	-----	-----		Bar not ruptured.

No. 384.

Marks, 82 C.

Gautier steel bar. 0.82 per cent carbon. Hot rolled bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Un-loaded.	Load-ed.	Un-load-ed.			
Pounds 55,000	0	0	a	Inch. .1556	Inch. .1109	Inch. .1554	Inch. .0445	Inch. .0002	Bar ruptured about mid-way between middle bearings. Bar run hot and stream of water played on it after 10,000 rotations.
			b	.1556	.1111	.1554	.0443	.0002	
1,000	1,000	a	.1536	.1050	.1514	.0464	.0022		
		b	.1597	.1064	.1524	.0460	.0073		
9,000	10,000	a	.1549	.1022	.1492	.0470	.0057		
		b	.1695	.1040	.1508	.0468	.0157		
83,790	93,790	-----				-----	-----	-----	

ENDURANCE OF ROTATING SHAFTS.

SUMMARIZED TABULATION.

Speed of rotation, 500 per minute.

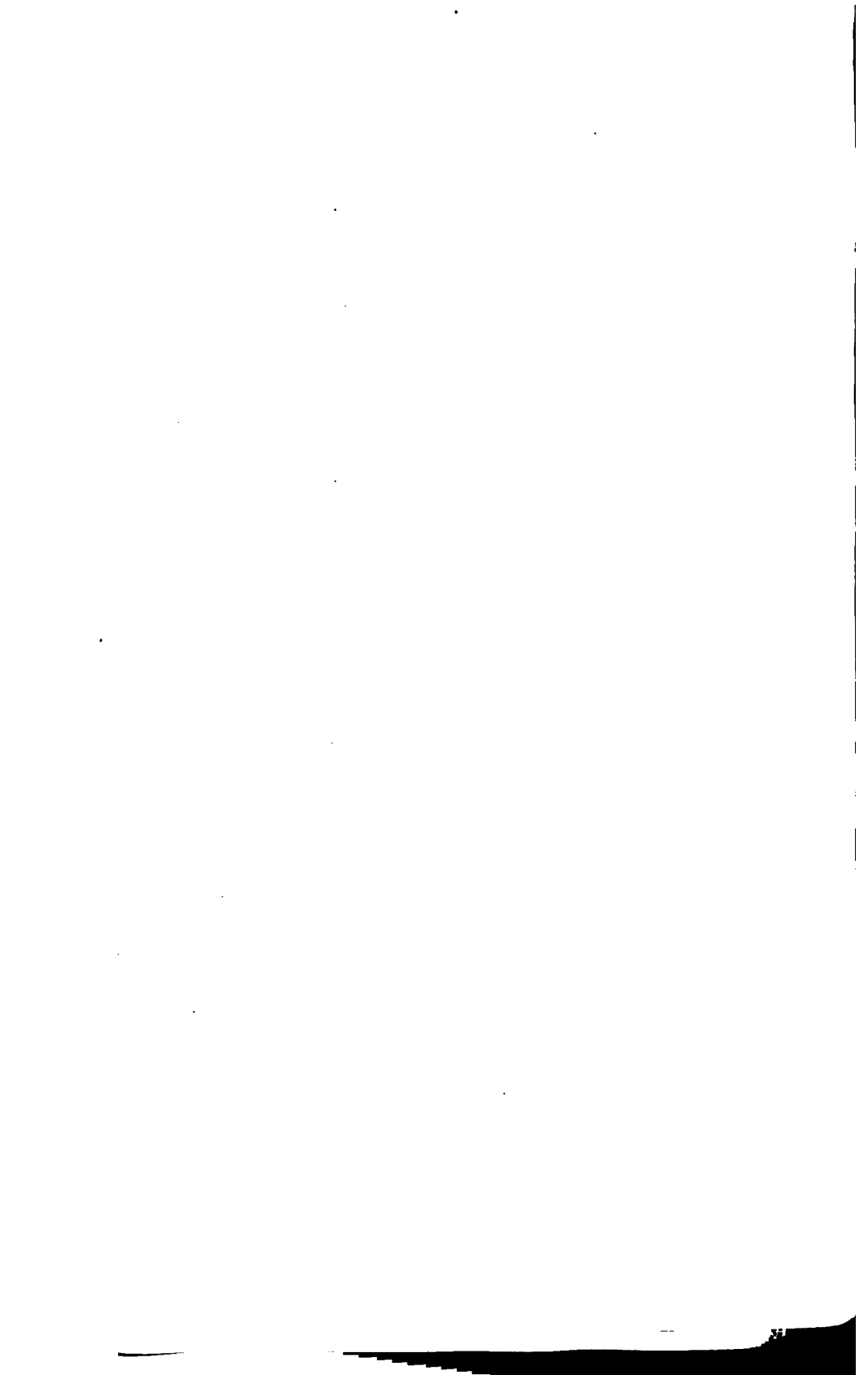
No. of test.	Marks.	Material.	Treatment.	Composition.				Maxi- mum number stress per square inch.	Number of rotations.		Remarks.
				C.	Mn.	Si.	Ni.		Successive.	Total.	
326	7×2, 9	Bethlehem steel.....	Hardened.....	.25	.66	.06	4.60	<i>Pounds.</i> 25,000,000 50,000,000 16,000,000 361,250	40,361,250	Bar ruptured 7/80 south of the south edge of north middle bearing.	
334	7×1, 10	.....do.....	.....do.....	.25	.52	.12	3.31	15,000,000 1,571,000	16,571,000	Bar ruptured at the south edge of middle bearing.
335	7×2, 2	.....do.....	Annealed at low heat.....	.25	.66	.06	4.60	14,000,000 1,451,880	15,451,880	Bar ruptured at the south edge of middle bearing.
337	7×2, 6	.....do.....	Oil-tempered and annealed at low heat.	.25	.66	.06	4.60	10,010,000 3,745,660	13,755,660	Bar ruptured at the north edge of middle bearing.
338	N 3-C	16"×18" nickel-steel ingot.	Natural state of ingot.....	.17	.68	.016	3.25	10,000 15,000 11,000 20,000 11,000 25,000 11,000 30,000	289,060	Bar ruptured 1/20 north of the north edge of south middle bearing.	
339	7×2, 7	Bethlehem steel.....	Oil-tempered and annealed at high heat.	.25	.66	.06	4.60	50,000,000 13,000,000 768,610	13,768,610	Bar ruptured 1" north of the north edge of north middle bearing.	
340	7×2, 8	.....do.....	.....do.....	.25	.66	.06	4.60	50,000 2,998,070 60,000 13,965,120	\$2,965,120	Bar ruptured about midway between die bearings.
341	7×2, 4	.....do.....	Annealed at high heat.....	.25	.66	.06	4.60	50,000 2,962,730	2,962,730	Bar ruptured 1 1/4" north of the north edge of south middle bearing.
342	7×2, 10	.....do.....	Hardened.....	.25	.66	.06	4.60	50,000 2,962,960	2,962,960	Bar ruptured 7/30 south of the south edge of north middle bearing.
343	C 3-B.	16"×18" carbon-steel ingot.	Heated low cherry and quenched in oil.	.20	.58	.015	.....	20,000 10,000 25,000 8,960,000 787,990	7,787,990	Bar ruptured 1" south of the south edge of north middle bearing.

344	Rail 40	Cammell steel, 1872...	Toughened.....	.48	.175	30,000	10,000	3,668,520	Bar ruptured 1/40 south of the south edge of north middle bearing.
345	Rail 41	do.....	do.....			36,000	190,000	686,480	Bar ruptured at north edge of north middle bearing.
346	Rail 43	Barrow steel, 1873	do.....			40,000	686,480	42,527,670	Bar ruptured in the south middle bearing.
347	Rail 47	Sheffield Atlas steel	do.....	.68	.122	40,000	7,240,000	8,249,000	Bar ruptured 1/60 north of the north edge of south middle bearing.
348	Rail 49	Petlm Gaudet	do.....	.41	.065	40,000	818,880	818,880	Bar ruptured 1/70 north of the north edge of south middle bearing.
349	Rail 51	Landore Siemens steel, 11.78.	do.....	.41	.018	40,000	524,760	524,760	Bar ruptured 2/70 north of the north edge of north middle bearing.
350	C 5-A.	16" x 18" carbon-steel Wingot.	Heated white hot and quenched in brine.	.20	.015	40,000	568,910	568,910	Bar ruptured 1/80 north of the north edge of north middle bearing.
351	Rail 52	Wilson-Cammell-Dowais steel, 10.70 guaranteed.	do.....	.50	.047	40,000	2,907,810	2,907,810	Bar ruptured 1/10 north of the north edge of south middle bearing, at a point 1/125 from the circumference of the bar and at about right angles to the top of the rail.
352	C 5-B	16" x 18" carbon-steel Ingot.	Heated bright yellow and quenched in oil.	.20	.015	40,000	118,960	118,960	Bar ruptured 1/50 south of the south edge of north middle bearing.
353	C 5-C	do.....	Heated bright yellow, quenched in oil, and annealed at 1,000° F.	.20	.015	40,000	88,480	88,480	Bar ruptured at south edge of north middle bearing.
354	C 5-D	do.....	Heated bright yellow and cooled in sand.	.20	.015	40,000	8,820	8,820	Do.
355	N 5-A	16" x 18" nickel-steel Ingot.	Heated white hot and quenched in brine.	.17	.06	40,000	40,880	40,880	Bar ruptured at the south edge of south middle bearing, at a smooth spot 1/20 x 1/16 at circumference of bar.
356	N 5-B	do.....	Heated bright yellow and quenched in oil.	.17	.06	40,000	98,480	98,480	Bar ruptured 1/75 north of the north edge of south middle bearing, at three smooth spots.
357	N 5-C	do.....	Heated bright yellow, quenched in oil, and annealed at 1,000° F.	.17	.06	40,000	19,960	19,960	Bar ruptured 1/90 north of the north edge of north middle bearing, at a smooth spot 1/70 x 1/30.
358	N 5-D	do.....	Heated bright yellow and cooled in sand.	.17	.06	40,000	48,110	48,100	Bar ruptured 1/50 north of the north edge of south middle bearing, at a smooth spot 1/25 x 1/10 at the circumference of bar.
359	C 3-C	16" x 18" carbon-steel Ingot.	Heated bright red and quenched in oil.	.20	.015	40,000	108,860	108,860	Bar ruptured 1/70 north of the north edge of north middle bearing, at a blowhole 1/16 diameter, near circumference of bar.
360	N 3-B	16" x 18" nickel-steel Ingot.	Heated low cherry and quenched in oil.	.17	.06	40,000	22,900	22,900	Bar ruptured 5/75 south of the south edge of south middle bearing, at a series of smooth spots or streaks running across the bearing.
361	Rail 56	28 P. S. Co. 85	do.....	.45	.013	40,000	8,768,860	8,768,860	Bar ruptured in the south middle bearing, about the middle of the bearing.

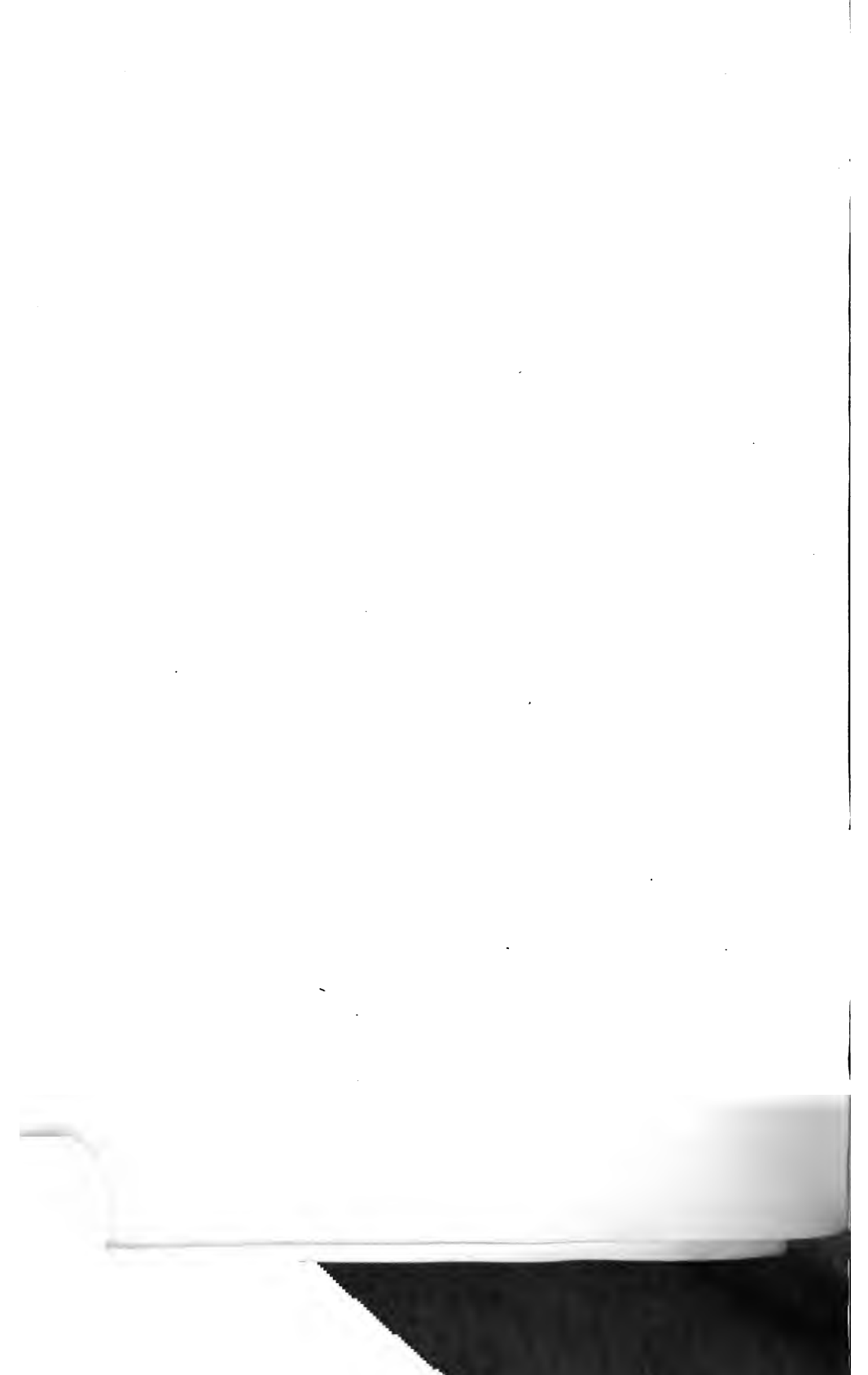
SUMMARIZED TABULATION—Continued.

No. of test.	Marks.	Material.	Treatment.	Composition.			Maxi- mum fiber stress per square inch.	Number of rotations.		Remarks.
				C.	Mn.	Si.		Ni.	Successive.		Total.
362	Rail 60	Cammell steel, 1873.	Toughened.....	.39	.48	.041	Pounds. 40,000	3,824,840	3,824,840	Bar ruptured in the north middle bearing.
363	Rail 62	Landore 2-72.	.....	.51	.41	.045	40,000	51,100	51,100	Bar ruptured 7/70 north of the north edge of south middle bearing. Bar run hot and stream of water played on it after first 11,000 rotations.
364	Rail 63	.....do	.....	.44	.36	.047	40,000	62,240	62,240	Bar ruptured at the north edge of south middle bearing. Bar run hot and stream of water played on it after first 7,000 rotations.
365	7x3,1	Bethlehem steel.....	Annealed at low heat.....	.29	.76	.14	50,000 55,000 60,000	21,000,000 6,000,000 970,450	27,970,450	Bar ruptured in the south middle bearing. The south end bearing was reduced to 7/84 diameter from wear.
366	7x3,2	.....do	.....do	.29	.76	.14	50,000 55,000 60,000	21,000,000 6,008,960 588,200	27,548,160	Bar ruptured at the north edge of south middle bearing. South end bearing was reduced to 7/86 diameter from wear.
367	D	Burdin's best iron	Natural state.....	.....	.....	.....	20,000 25,000	10,000 2,706,380	2,716,380	Bar ruptured 7/70 south of the south edge of north middle bearing.
368	A	.....do	Twisted two turns in 45°	.....	.....	.....	25,000	3,082,180	3,082,180	Bar ruptured in the north middle bearing.
369	B	.....do	Twisted three turns in 45°	.....	.....	.....	25,000	12,074,960	12,074,960	Bar ruptured in the north middle bearing.
370	C	.....do	Twisted four turns in 45°	.....	.....	.....	25,000	7,043,060	7,043,060	Do.
371	17 C	Gautier steel	Hot rolled bar.....	.17	.57	.04	60,000	6,470	6,470	Bar ruptured 17/100 north of the north edge of south middle bearing. Bar run hot and stream of water played on it during test.
372	17 C	.....do	.....do	.17	.57	.04	50,000	17,790	17,790	Bar ruptured midway between middle bearing. Bar run hot and stream of water played on it during test.
373	17 C	.....do	.....do	.17	.57	.04	45,000	70,400	70,400	Bar ruptured 17/100 south of the south edge of north middle bearing. Bar run hot and stream of water played on it after first 1,000 revolutions.
374	17 C	.....do	.....do	.17	.57	.04	40,000	286,510	286,510	Bar ruptured in south middle bearing.
375	17 C	.....do	.....do	.17	.57	.04	30,000	6,420,710	6,420,710	Bar run rather warm. Bar not ruptured.

376	17 C	.....do.....	.....do.....	.....do.....	.17	.57	.04	.....	35,000	5,757,920	5,757,920	Bar ruptured $1/40$ south of the south edge of north middle bearing.
377	55 C	.....do.....	.....do.....	.....do.....	.55	.75	.14	.....	60,000	12,490	12,490	Bar ruptured $1/25$ south of the south edge of north middle bearing. Bar run hot and stream of water played on it after first 1,000 revolutions.
378	55 C	.....do.....	.....do.....	.....do.....	.55	.75	.14	.....	50,000	98,160	98,160	Bar run hot and stream of water played on it after first 1,000 revolutions.
379	55 C	.....do.....	.....do.....	.....do.....	.55	.75	.14	.....	45,000	166,240	166,240	Bar run hot and stream of water played on it after first 1,000 revolutions.
380	55 C	.....do.....	.....do.....	.....do.....	.55	.75	.14	.....	40,000	455,850	455,850	Bar run hot and stream of water played on it after first 1,000 revolutions.
381	55 C	.....do.....	.....do.....	.....do.....	.55	.75	.14	.....	35,000	900,720	900,720	Bar ruptured $1/60$ north of the north edge of south middle bearing. Bar run hot and stream of water played on it after 10,000 revolutions.
382	82 C	.....do.....	.....do.....	.....do.....	.82	.86	.10	.....	60,000	37,250	37,250	Bar run hot and stream of water played on it after first 1,000 revolutions.
383	55 C	.....do.....	.....do.....	.....do.....	.55	.75	.14	.....	30,000	810,630	810,630	Bar not ruptured.
384	82 C	.....do.....	.....do.....	.....do.....	.82	.86	.10	.....	55,000	98,790	98,790	Bar ruptured about midway between middle bearings. Bar run hot and stream of water played on it after 10,000 revolutions.



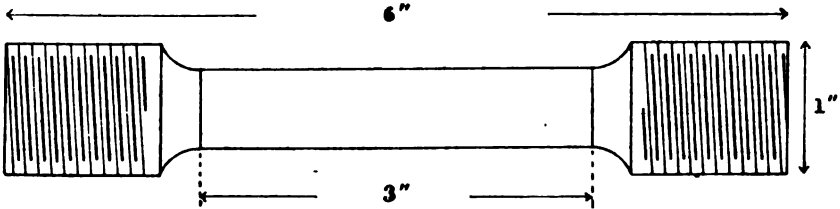
**TENSILE SPECIMENS FROM ENDURANCE TESTS
OF ROTATING SHAFTS.**



TENSILE SPECIMENS FROM RUPTURED ENDURANCE SHAFTS.

SPECIMENS TAKEN FROM THE ENDS OF RUPTURED BARS.

The marks give the test number of the endurance shaft, also the figures and letters which were employed to identify the grade or treatment of the metal.



The results are grouped according to the classes of material represented. Specimens in each group follow each other in the order of their endurance-test number.

TREATED STEEL BARS FROM THE BETHLEHEM STEEL CO.

No. 7682.

Hardened.

Marks, 326, 7×2-9.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0021	.....
30,000	.0032	.0001	
35,000	.0038	.....
40,000	.0047	.0004	
41,000	.0049	.....
42,000	.0052	.....
43,000	.0054	.....
44,000	.0057	.....
45,000	.0059	.0009	
46,000	.0061	.....
47,000	.0062	.....
48,000	.0064	.....
49,000	.0067	.....
50,000	.0069	.0014	
51,000	.0070	.....
52,000	.0072	.....
53,000	.0075	.....
54,000	.0079	.....
55,000	.0081	.0020	
56,000	.0085	.....
57,000	.0088	.....
58,000	.0090	.....
59,000	.0092	.....
60,000	.0099	.0081	
62,000	.0105	.....
64,000	.0112	.....
66,000	.0122	.....
68,000	.0139	.....
70,000	.0150	.0070	
72,000	.0162	.....
74,000	.0179	.....
76,000	.0203	.....
78,000	.0225	.....
80,000	.0257	.0161	
84,000	.03	.....
88,000	.04	.....
92,000	.05	.....
96,000	.07	.....
100,000	.08	.....
104,000	.09	.....
108,000	.11	.....
112,000	.13	.....
116,000	.17	.....
120,000	.29	.....	Tensile strength.
0	.38	.....	=12.7 per cent.

Elongation of inch sections, ".06, ".14, ".18*.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Appearance of fracture, silky, oblique.

No. 7657.

Hardened.

Marks, 334, 7 × 1-10.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0031	.....
40,000	.0041	0.	
45,000	.0047	.....
48,000	.0051	.....	Elastic limit.
49,000	.0054	.....
50,000	.0059	.0007	
51,000	.0063	.....
52,000	.0068	.....
53,000	.0071	.....
54,000	.0075	.....
55,000	.0079	.....
56,000	.0087	.....
57,000	.0096	.....
58,000	.0113	.....
59,000	.0158	.....
60,000	.0218	.0147	
62,000	.0258	.....
64,000	.0314	.....
68,000	.0450	.....
72,000	.0596	.....
76,000	.0750	.....
80,000	.0948	.0842	
88,000	.15	.....
92,000	.21	.....
95,760	.....	.....	Tensile strength.
0	.63	.....	= 21 per cent.

Elongation of inch sections, ".09, ".17, ".37*.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 59.3 per cent.

Appearance of fracture, fine silky, cup-shaped.

Marked as per note.
 Marks, 335, 7x2-2.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0009	.....	
20,000	.0020	.....	
30,000	.0031	.....	
40,000	.0041	0.		
45,000	.0047	0.		
50,000	.0052	0.		
55,000	.0059	0.		
60,000	.0064	0.		
63,000	.0068	.....	
60,000	.0118	.0050		Elastic limit.
60,000	.0120	.0053		Load fell.
61,000	.0142		Load repeated.
62,000	.0175		
63,000	.0230	.....	
64,000	.0280	.....	
66,000	.0368	.....	
68,000	.0428	.....	
70,000	.0509	.....	
72,000	.0585	.....	
74,000	.0650	.....	
76,000	.0720	.....	
78,000	.0810	.....	
80,000	.0933	.0625		
84,000	.11	.....	
88,000	.15	.....	
92,000	.20	.....	
96,000	.32	.....	
97,200	.....	.....	Tensile strength.
0	.65	.....	=21.7 per cent.

Elongation of inch sections, ".15, ".37*, ".13.
 Diameter at fracture, ".40; area, .1257 square inch.
 Contraction of area, 49.7 per cent.
 Appearance of fracture, fine silky, cup-shaped.

No. 7659.

Oil tempered and annealed at low heat.
 Marks, 337, 7×2-6.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	Elastic limit.
10,000	.0010	.....
20,000	.0021	.....
30,000	.0031	.....
40,000	.0043	0.	
45,000	.0049	.0001	
49,000	.0054	.....
50,000	.0059	.0004	
51,000	.0062	.....
52,000	.0068	.....
53,000	.0077	.....
54,000	.0100	.....
55,000	.0140	.....
56,000	.0160	.....
58,000	.0225	.....
60,000	.0276	.0279	
62,000	.0380	.....
64,000	.0490	.....
66,000	.0570	.....
68,000	.0650	.....
70,000	.0750	.....
72,000	.0849	.....
76,000	.1060	.....
80,000	.1312	.....
84,000	.17	.....
88,000	.23	.....
92,000	.35	.....
92,960	Tensile strength.
0	.75	=25 per cent.

Elongation of inch sections, ".14, ".45*, ".16.
 Diameter at fracture, ".35; area, .0962 square inch.
 Contraction of area, 61.5 per cent.
 Appearance of fracture, fine silky, cup-shaped.

No. 7683.

Oil tempered and annealed at high heat.

Marks, 339, 7×2-7.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0010	-----	
20,000	.0021	-----	
30,000	.0033	0.	
35,000	.0039	-----	
40,000	.0045	0.	
50,000	.0056	0.	
55,000	.0060	0.	
60,000	.0066	0.	
65,000	.0070	0.	
70,000	.0076	0.	
75,000	.0080	0.	
80,000	.0087	0.	
85,000	.0091	0.	
90,000	.0097	0.	
95,000	.0101	0.	
100,000	.0108	0.	
105,000	.0112	0.	
110,000	.0119	0.	
115,000	.0122	0.	
120,000	.0131	.0008	Elastic limit.
121,000	.0360	-----	
122,000	.05	-----	
124,000	.06	-----	
126,000	.08	-----	
128,000	.09	-----	
130,000	.11	-----	
132,000	.15	-----	
134,000	.18	-----	
135,920	-----	-----	Tensile strength.
0	.49	-----	= 16.3 per cent.

Elongation of inch sections, ".09, ".33*, ".07.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 59.3 per cent.

Appearance of fracture, fine silky, serrated.

No. 7808.

Oil tempered and annealed at high heat.
 Marks, 340, 7×2-8.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0004	0.		
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.....	
40,000	.0041	0.		
50,000	.0053	0.		
60,000	.0063	0.		
70,000	.0074	0.		
80,000	.0084	0.		
90,000	.0095	0.		
98,000	.0106		Elastic limit.
99,000	.0108	.....	
100,000	.0111	.0009		
101,000	.0127	.....	
102,000	.0142	.....	
103,000	.0160	.....	
104,000	.0183	.....	
105,000	.0210	.....	
106,000	.0238	.....	
108,000	.0310	.0188		
112,000	.06	Tensile strength. =15.1 per cent.	
116,000	.07	.....	
120,000	.10	.....	
124,000	.15	.....	
127,200	.....	.....
0	.46	.....	

Elongation of inch sections, ".05, ".16, ".25*.
 Diameter at fracture, ".37; area, .1075 square inch.
 Contraction of area, 57 per cent.
 Appearance of fracture, fine silky, serrated.

No. 7661.

Annealed at high heat.

Marks, 341, 7×2-4.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0021	.....
30,000	.0032	0.	
35,000	.0039	.....
40,000	.0047	.0002	
41,000	.0049	.....
42,000	.0050	.....
43,000	.0052	.....		Elastic limit.
44,000	.0058	.....
45,000	.0061	.....
46,000	.0068	.....
47,000	.0072	.....
48,000	.0082	.....
49,000	.0093	.....
50,000	.0122	.0064	
52,000	.0170	.....
54,000	.0250	.....
56,000	.0313	.....
60,000	.0470	.0892	
64,000	.06	.....
68,000	.08	.....
72,000	.10	.....
76,000	.13	.....
80,000	.16	.....
84,000	.21	.....
88,000	.30	.....
89,680	Tensile strength. = 21.7 per cent.
0	.65	.....

Elongation of inch sections, ".11, ".30*, ".24*.

Diameter at fracture, ".42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, fine silky.

No. 7868.

Annealed at low heat.
 Marks, 365, 7 × 3-1.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0021	.....
30,000	.0031	.....
40,000	.0042	0.	
50,000	.0053	.....
60,000	.0064	0.	
65,000	.0069	.....
70,000	.0075	0.	
75,000	.0081	.....
76,000	.0083	.....
77,000	.0085	.....
78,000	.0087	.....
79,000	.0090	.....
80,000	.0094	.0009	
81,000	.0098	.....
82,000	.0102	.....
83,000	.0105	.....
84,000	.0110	.....
85,000	.0118	.0026	
86,000	.0130	.....
87,000	.0136	.....
88,000	.0144	.....
89,000	.0155	.....
90,000	.0175	.0076	
92,000	.0218	.....
94,000	.0266	.....
96,000	.0335	.....
98,000	.0487	.....
100,000	.0621	.0400	
104,000	.07	.....
106,000	.10	.....
112,000	.14	.....
116,000	.20	.....
117,280	.....	.....
0	.55	.....

Elastic limit.

Tensile strength.
 = 18.3 per cent.

Load on bar at time of rupture, 21,800 pounds = 192,240 pounds per square inch on area at fracture.

Elongation of inch sections, ".17, ".29*, ".09.

Diameter at fracture, ".38; area, .1134 square inch.

Contraction of area, 54.6 per cent.

Fractured 1".35 from the neck.

Appearance of fracture, fine silky, serrated, cup-shaped.

Marks, 366, 7 × 3-2.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0008	.....	
20,000	.0018	.....	
30,000	.0028	-.0001		
40,000	.0038	.....	
50,000	.0049	.....	
60,000	.0060	-.0002		
65,000	.0065	.....	
70,000	.0070	-.0002		
75,000	.0076	.....	
79,000	.0080	.....	
80,000	.0085	0.		Elastic limit.
81,000	.0089	.....	
82,000	.0093	.....	
83,000	.0096	.....	
84,000	.0103	.....	
85,000	.0109	.0019		
86,000	.0119	.....	
87,000	.0127	.....	
88,000	.0139	.....	
89,000	.0152	.....	
90,000	.0177	.0077		
92,000	.0210	.....	
94,000	.0271	.....	
96,000	.0346	.....	
98,000	.0445	.....	
100,000	.0532	.0411		
104,000	.07	.....	
108,000	.10	.....	
110,000	.14	.....	
116,000	.21	.....	
116,800	.38	Tensile strength. = 18 per cent.	
0	.54	.....	

Load on bar at time of rupture, 22,200 pounds = 195,770 pounds per square inch on area at fracture.
 Elongation of inch sections, ".08, ".13, ".33*.
 Diameter at fracture, ".38; area, .1134 square inch.
 Contraction of area, 54.6 per cent.
 Fractured, 1" from the neck.
 Appearance of fracture, fine silky, serrated, cup-shaped.

TABULATION OF TENSION SPECIMENS FROM ENDS OF BARS RUPTURED BY ENDURANCE TESTS OF ROTATING SHAFTS.

TREATED STEEL BARS FROM THE BETHEHEM STEEL COMPANY.

SECTIONAL AREA. .25 SQUARE INCH; GAUGED LENGTH, 3".

Tension test number.	Endurance test number.	Description.	Carbon	Nickel.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction.	Elongation of inch sections.	Appearance of fracture.
7682	826	Hardened.....	Per cent. 0.26	Per cent. 4.60	Pounds. 120,000	Pounds. 120,000	Per cent. 24.8	Per cent. 24.8	" "	Silky oblique.
7687	824	do.....	.26	8.81	48,000	95,760	19.7	19.7	0.06, 0.14, 0.18*	Fine silky, cup-shaped.
7688	825	Annnealed at low heat.....	.26	4.60	63,000	97,200	21.0	58.7	.09, .17, .37*	Do.
7689	827	Oil tempered and annealed at low heat.....	.26	4.60	49,000	92,960	21.7	48.7	.15, .37*, .16	Do.
7692	829	Oil tempered and annealed at high heat.....	.26	4.60	120,000	135,920	16.8	61.5	.14, .45*, .16	Fine silky, serrated.
7698	830	do.....	.26	4.60	98,000	127,200	15.1	59.3	.09, .33*, .07	Do.
7699	831	Annnealed at high heat.....	.26	4.60	48,000	89,680	21.7	57.0	.05, .15, .25*	Fine silky.
7695	865	Annnealed at low heat.....	.26	.....	78,000	117,280	18.8	54.6	.11, .29*, .09	Fine silky, serrated, cup-shaped.
7696	866	do.....	.26	.....	80,000	116,800	18.0	54.6	.08, .15, .33*	Do.

a Indefinite.

METAL FROM 16" BY 18" CARBON STEEL INGOT.

No. 7684.

Heated low cherry and quenched in oil.

Marks, 343, C 3-B.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	0.	Elastic limit.
20,000	.0019	0.	
30,000	.0030	0.	
35,000	.0039	.0002	
36,000	.0044	.....
37,000	.0048	.....
38,000	.0051	.....
39,000	.0054	.....
40,000	.0059	.0017	
41,000	.0064	.....
42,000	.0073	.....
43,000	.0079	.....
44,000	.0083	.....
45,000	.0090	.0040	
46,000	.0099	.....
47,000	.0109	.....
48,000	.0127	.....
49,000	.0140	.....
50,000	.0167	.0106	
52,000	.0196	.....
54,000	.0270	.....
56,000	.0340	.....
58,000	.0405	.....
60,000	.0498	.0422	
64,000	.07	.....
68,000	.10	.....
72,000	.13	.....
76,000	.19	.....
80,000	.37	.....
0	.40	Tensile strength. = 13.3 per cent.

Elongation of inch sections, ".09, ".20*, ".11.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Appearance of fracture, granular.

No. 7748.

Heated white hot and quenched in brine.

Marks, 350, C 5-A.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0009	0.		
20,000	.0019	0.		
30,000	.0029	0.		
35,000	.0034	0.		
40,000	.0039	0.		
45,000	.0045	0.		
47,000	.0048		Elastic limit.
48,000	.0050	.....	
49,000	.0053	.....	
50,000	.0057	.0006		
51,000	.0060	.....	
52,000	.0065	.....	
53,000	.0069	.....	
54,000	.0073	.....	
55,000	.0079	.0021		
56,000	.0084	.....	
57,000	.0091	Rested under initial load 1 hour.	
58,000	.0098	.....	
59,000	.0106	.....	
60,000	.0118	.0053		
61,000	.0122	.....	
62,000	.0131	.....	
63,000	.0142	.....	
64,000	.0158	.....	
66,000	.0180	.....	
68,000	.0212	.....	
70,000	.0241	.0164		
76,000	.04	Tensile strength. = 3.7 per cent.	
80,000	.06	.....	
84,000	.07	.....	
87,600	.....	.....
0	.11	.....	

Elongation of inch sections, ".01, ".02, ".08*.

Diameter at fracture, ".52; area, .2124 square inch.

Contraction of area, 15 per cent.

Appearance of fracture, irregular, gray, amorphous, 60 per cent; fine granular, 40 per cent.

Heated bright yellow and quenched in oil.
 Marks, 352, C 5-B.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0010	0.		
20,000	.0020	0.		
30,000	.0030	0.		
35,000	.0036	.0001		
38,000	.0038	.....	
39,000	.0040	.....	
40,000	.0046	.0007		Elastic limit.
41,000	.0048	.....	
42,000	.0050	.....	
43,000	.0052	.....	
44,000	.0056	.....	
45,000	.0059	.0013		
46,000	.0063	.....	
47,000	.0068	.....	
48,000	.0072	.....	
49,000	.0078	.....	
50,000	.0087	.0035		
52,000	.0101	.....	
54,000	.0130	.....	
56,000	.0170	.....	
58,000	.0221	.....	
60,000	.0285	.0214		
64,000	.04	.....	
68,000	.06	.....	
72,000	.08	.....	
76,000	.10	.....	
80,000	.14	.....	
83,920	Tensile strength. =9.7 per cent.	
0	.29	.....	

Elongation of inch sections, ".08, ".07, ".14*.
 Diameter at fracture, ".50; area, .1964 square inch.
 Contraction of area, 21.4 per cent.
 Appearance of fracture, oblique, irregular, gray, amorphous.

No. 7751.

Heated bright yellow, quenched in oil, and annealed at about 1,000° F.

Marks, 353, C 5-C.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0008	0.		
10,000	.0009	0.		
20,000	.0019	0.		
30,000	.0029	0.		
35,000	.0034	0.		
40,000	.0039	.0001		Elastic limit.
45,000	.0045	.....	
46,000	.0050	.....	
47,000	.0070	.....	
48,000	.0108	.....	
49,000	.0140	.....	
50,000	.0189	.0131		
51,000	.0209	.....	
52,000	.0250	.....	
53,000	.0283	.....	
54,000	.0320	.....	
56,000	.0410	.....	
58,000	.0425	.....	
60,000	.0591	.0517	Tensile strength. =9 per cent.	
64,000	.08	.....	
68,000	.10	.....	
72,000	.14	.....	
76,000	.24	.....	
0	.27	.....	

Elongation of inch sections, ".08, ".13*, ".06.

Diameter at fracture, ".52; area, .2124 square inch.

Contraction of area, 15 per cent.

Appearance of fracture, irregular, gray, amorphous.

No. 7752.

Heated bright yellow, and cooled in sand.

Marks, 354, C 5-D.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....
20,000	.0020	.....
25,000	.0027	.....	Elastic limit.
27,000	.0067	.....
28,000	.0068	.....
29,000	.0227	.....
30,000	.0268	.0281	
31,000	.0280	.....
32,000	.0323	.....
33,000	.0362	.....
34,000	.0410	.....
35,000	.0448	.0402	
36,000	.0475	.....
37,000	.0500	.....
38,000	.0570	.....
39,000	.0612	.....
40,000	.0672	.0622	
42,000	.08	.....
44,000	.09	.....
46,000	.11	.....
48,000	.13	.....
50,000	.15	.....
52,000	.17	.....
54,000	.20	.....
56,000	.24	.....
60,000	.35	.....
61,920	.....	.....	Tensile strength.
0	.67	.....	=22.3 per cent.

Elongation of inch sections, ".17, ".28*, ".22.

Diameter at fracture, ".48; area, .1810 square inch.

Contraction of area, 27.6 per cent.

Appearance of fracture, irregular, gray, amorphous.

No. 7756.

Heated bright red and quenched in oil.
 Marks, 359, C 3-C.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0003	0.		
10,000	.0009	.....	
20,000	.0019	0.		
30,000	.0030	0.		
35,000	.0035	.....	
40,000	.0040	0.		
45,000	.0047	.0001		Elastic limit, approximate.
46,000	.0049	.....	
47,000	.0051	.....	
48,000	.0053	.....	
49,000	.0057	.....	
50,000	.0060	.0010		
52,000	.0070	.....	
54,000	.0088	.....	
56,000	.0109	.....	
58,000	.0132	.....	
60,000	.0170	.0102	Tensile strength. = 9.3 per cent.	
62,000	.0200	.....	
64,000	.0253	.....	
66,000	.0310	.....	
68,000	.0378	.....	
70,000	.0460	.0371		
76,000	.07	.....	
80,000	.09	.....	
84,000	.12	.....	
88,000	.17	.....	
89,280	.....	.....
0	.28	.....	

Elongation of inch sections, ".16*, ".06, ".06.
 Diameter at fracture, ".50; area, .1964 square inch.
 Contraction of area, 21.4 per cent.
 Appearance of fracture, irregular, gray, amorphous.

TABLATION OF TENSION SPECIMENS FROM ENDS OF BARS RUPTURED BY ENDURANCE TESTS OF ROTATING SHAFTS.

METAL FROM 16" BY 18" CARBON STEEL INGOT.

SECTIONAL AREA, .25 SQUARE INCH; GAUGED LENGTH, 3".

Tension test numbers.	Endurance test numbers.	Description.	Carbon.	Nickel.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
7684	343	Heated low cherry and quenched in oil.	Per cent. .20	Per cent.	Pounds. 38,000	Pounds. 80,000	Per cent. 13.3	Per cent. 21.4	" .09, .20*, .11	Granular.
7748	350	Heated white hot and quenched in brine.	.20	.....	47,000	87,600	3.7	15.0	.01, .02, .08*	Irregular, gray, amorphous, 60 per cent; fine granular, 40 per cent.
7760	352	Heated bright yellow and quenched in oil.	.20	.....	39,000	88,920	9.7	21.4	.08, .07, .14*	Oblique, irregular, gray, amorphous.
7751	353	Heated bright yellow, quenched in oil, and annealed at about 1,000° F.	.20	.....	45,000	76,000	9.0	15.0	.08, .13*, .06	Irregular, gray, amorphous.
7782	354	Heated bright yellow and cooled in sand.	.20	.....	26,000	61,920	22.3	27.6	.17, .28*, .22	Do.
7756	359	Heated bright red and quenched in oil.	.20	.....	c 45,000	89,280	9.3	21.4	.16*, .08, .06	Do.

c Approximate.

METAL FROM 16" by 18" NICKEL STEEL INGOT.

No. 7660.

Natural state of ingot.
 Marks, 338, N 3-C.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
20,000	.0021	0.	
25,000	.0027	0.	
30,000	.0032	.0001	Elastic limit.
31,000	.0036	-----	
32,000	.0040	-----	
33,000	.0042	-----	
34,000	.0048	-----	
35,000	.0051	.0012	
36,000	.0061	-----	
37,000	.0069	-----	
38,000	.0087	-----	
40,000	.0142	.0098	
42,000	.0225	-----	
44,000	.0320	-----	
46,000	.0450	-----	
48,000	.0580	-----	
50,000	.0725	.0663	
52,000	.09	-----	
56,000	.13	-----	
60,000	.19	-----	
64,000	.35	-----	
64,480	-----	-----	Tensile strength. = 16.7 per cent.
0	.50	-----	

Elongation of inch sections, ".22*", ".16, ".12.
 Diameter at fracture, ".48; area, .1810 square inch.
 Contraction of area, 27.6 per cent.
 Appearance of fracture, dull amorphous, irregular surface.

Marks, 355, N 5-A.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	0.	
40,000	.0040	0.	
50,000	.0050	0.	
60,000	.0061	0.	
65,000	.0069	.0001	
70,000	.0078	.0004	
75,000	.0089	.0007	
80,000	.0098	.0009	
85,000	.0105	.0012	
90,000	.0113	.0017	
95,000	.0123	Tensile strength. = 0.7 per cent.
0	.02	.....

Elastic limit indefinite.

Elongation of inch sections, ".00, ".01, ".01*.

Contraction of area, inappreciable.

Appearance of fracture, granular. The fractured surface displayed a bright, smooth, splendent spot ".3 by ".2, the edges of which were darkened, apparently by the oil used about the lathe when turning the specimen.

No. 7754.

Heated bright yellow and quenched in oil.
 Marks, 356, N 5-B.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	
10,000	.0010		
20,000	.0021		
30,000	.0081	0.	
35,000	.0087	.0001	
40,000	.0048	.0008	
45,000	.0054	.0006	
50,000	.0064	.0012	
55,000	.0074	.0017	
70,000	.0124	.0049	
75,000	.0160	.0079	
80,000	.0198	.0109	
85,000	.0268	.0168	
87,000			Tensile strength.
0	.06		= 2 per cent.

Elastic limit, indefinite.
 Elongation of inch sections, ".05*, ".01, ".00.
 Diameter at fracture, ".54; area, .2290 square inch.
 Contraction of area, 8.4 per cent.
 Appearance of fracture, silky, oblique. The fractured surface contains a smooth, bright, splendent spot ".20 by ".30.

Heated bright yellow and cooled in sand.
 Marks, 358, N 5-D.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....
20,000	.0019	0.	
30,000	.0031	.0002	
35,000	.0036	.0002	
40,000	.0042	.0008	Elastic limit.
41,000	.0050	.....
42,000	.0250	.....
43,000	.0291	.....
44,000	.0340	.....
45,000	.0380	.....
46,000	.0445	.0390	
48,000	.0476	.....
47,000	.0518	.....
48,000	.0535	.....
49,000	.0635	.....
50,000	.0735	.0673	
52,000	.08	.....
55,000	.12	.....
60,000	.16	.....
64,000	.22	.....
67,840	.....	.....	Tensile strength.
0	.46	.....	= 15.3 per cent.

Elongation of inch sections, ".22*", ".13", ".11.
 Diameter at fracture, ".48; area, .1810 square inch.
 Contraction of area, 27.6 per cent.
 Appearance of fracture, dull gray, amorphous.

No. 7757.

Heated low cherry and quenched in oil.
 Marks, 360, N 3-B.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....
20,000	.0020	0.	
30,000	.0081	.0001	
35,000	.0088	.0002	
40,000	.0051	.0010	
45,000	.0065	.0017	
46,000	.0070	.....
47,000	.0073	.....
48,000	.0077	.....
49,000	.0080	.....
50,000	.0088	.0081	
52,000	.0096	.....
54,000	.0110	.....
56,000	.0130	.....
58,000	.0155	.....
60,000	.0190	.0119	
64,000	.03	.....
68,000	.04	.....
72,000	.05	.....
75,600	Tensile strength.
0	.11	= 8.7 per cent.

Elongation of inch sections, ".06*", ".03, ".02.

Diameter at fracture, ".53; area, .2206 square inch.

Contraction of area, 11.8 per cent.

Appearance of fracture, dull gray, coarsely fluted ends, smooth, lustrous ridges. Opened cracks in surface of stem.

TABULATION OF TENSION SPECIMENS FROM ENDS OF BARS RUPTURED BY ENDURANCE TESTS OF ROTATING SHAFTS.

METAL FROM 16" BY 18" NICKEL STEEL INGOT.

SECTIONAL AREA, .25 SQUARE INCH; GAUGED LENGTH, 3".

Tension test number.	Endurance test number.	Description	Carbon.	Nickel.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
7680	838	Natural state of ingot.	Per cent. .17	Per cent. 8.25	Pounds. 30,000	Pounds. 64,480	Per cent. 16.7	Per cent. 27.6	" "	
7753	856	Heated white hot and quenched in brine.	.17	8.25	(a)	96,000	0.7	(b)	.22*, .16, .12 .06, .01, .01*	Dull amorphous, irregular surface. Granular; bright, smooth spot.
7754	856	Heated bright yellow and quenched in oil.	.17	8.25	(a)	87,000	2.0	8.4	.06*, .01, .00	Silky, oblique; bright, smooth spot.
7755	858	Heated bright yellow and cooled in sand.	.17	8.25	40,000	67,840	15.3	27.6	.22*, .13, .11	Dull gray, amorphous.
7757	860	Heated low cherry and quenched in oil.	.17	8.25	(a)	75,600	8.7	11.8	.06*, .03, .02	Dull gray; smooth ridges; opened cracks in stem.

^a Indefinite.^b Inappreciable.

BURDEN'S BEST IRON—PLAIN AND TWISTED BARS.

No. 7809.

Natural state.

Marks, 367-D.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0021	.....
30,000	.0081	0.	Elastic limit. Load fell.
31,000	.0082	.....
32,000	.0083	.....
26,000	.0118	.....
	.0140	.....
27,000	.0169	.....
28,000	.0268	.....
29,000	.0608	.....
30,000	.0660	.0623	
31,000	.0723	.....
32,000	.0810	.....
33,000	.0900	.....
34,000	.1000	.....
36,000	.12	.....
38,000	.15	.....
40,000	.18	.....
42,000	.23	.....
44,000	.30	.....
46,000	.42	.....
48,000	Tensile strength.
0	1.00	=83.3 per cent.

Elongation of inch sections, ".23, ".52*, ".25.

Diameter at fracture, ".39; area, .1194 square inch.

Contraction of area, 52.2 per cent.

Appearance of fracture, fibrous.

Twisted two turns in 45°.

Marks, 368-A.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0021	.....
25,000	.0028	.0002	Elastic limit; approximate.
26,000	.0030	.....
27,000	.0033	.....
28,000	.0038	.....
29,000	.0041	.....
30,000	.0050	.0019	
31,000	.0060	.....
32,000	.0072	.....
33,000	.0088	.....
34,000	.0123	.....
35,000	.0146	.0104	
36,000	.0187	.....
38,000	.0310	.....
40,000	.0450	.....
42,000	.06	.....
44,000	.08	.....
46,000	.10	.....
48,000	.15	.....
50,000	.22	.....
51,840	.....	.....	Tensile strength.
0	.80	.....	=26.7 per cent.

Elongation of inch sections, ".16, ".46*, ".18.

Diameter at fracture, ".38; area, .1134 square inch.

Contraction of area, 54.6 per cent.

Appearance of fracture, fibrous.

No. 7870.

Twisted 3 turns in 45".
 Marks, 369-B.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0009	.....
20,000	.0019	.....
25,000	.0024	0.	
30,000	.0032	.0001	
31,000	.0034	.....
32,000	.0036	.....
33,000	.0038	.....
34,000	.0042	.....
35,000	.0044	.0007	
36,000	.0050	.....
37,000	.0053	.....
38,000	.0059	.....
39,000	.0069	.....
40,000	.0085	.0040	
41,000	.0096	.....
42,000	.0127	.....
43,000	.0152	.....
44,000	.0210	.....
45,000	.0240	.0177	
46,000	.0269	.....
47,000	.0365	.....
48,000	.0460	.....
49,000	.0525	.....
50,000	.0639	.0675	
52,000	.0900	.....
54,000	.18	.....
56,000	.18	.....
57,600	.40	.....
0	.66	.....
			Tensile strength. =22 per cent.

Elongation of inch sections, ".15, ".38*, ".13.
 Diameter at fracture, ".40; area, .1257 square inch.
 Contraction of area, 49.7 per cent.
 Fractured 1".55 from the neck.
 Appearance of fracture, fibrous.

BURDEN'S BEST IRON—PLAIN AND TWISTED BARS.

TESTED BY ENDURANCE TESTS OF ROTATING SHAFTS.
SECTIONAL AREA, .25 SQUARE INCH; GAUGED LENGTH, 3".

Tension test number.	Endurance test number.	Description.	Elastic limit per sq. in.	Tensile strength per sq. in.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
7809	367	Natural state	Pounds. 82,000	Pounds. 48,000	Per cent. 33.3	Per cent. 52.2	" " "	Fibrous. Do. Do.
7810	368	Twisted two turns in 45".	a 25,000	51,840	26.7	54.6	.23, .52*, .25 .16, .46*, .18	
7870	369	Twisted three turns in 45".	(b)	57,600	22.0	49.7	.15, .38*, .13	

^a Approximate.

^b Indefinite.

METAL FROM HEADS OF OLD STEEL RAILS.

No. 7728.

Cammell toughened steel, 1872.

Marks, 344, Rail 40.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.	
1,000	0.	0.		
5,000	.0004	0.		
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0031	0.		
35,000	.0036	0.		
40,000	.0041	0.		
45,000	.0048	.0001		
47,000	.....	.....
50,000	.0060	.0008		Elastic limit, approximate.
51,000	.0064	.....	
52,000	.0068	.....	
58,000	.0071	.....	
54,000	.0075	.....	
55,000	.0080	.0021		
56,000	.0087	.....	
57,000	.0091	.....	
58,000	.0102	.....	
59,000	.0110	.....	
60,000	.0128	.0060		
62,000	.0161	.....	
64,000	.0225	.....	
66,000	.0283	.....	
68,000	.0367	.....	
70,000	.0458	.0370		
72,000	.06	.....	
76,000	.08	.....	
80,000	.11	.....	
84,000	.20	.....	
85,040	Tensile strength. =16.3 per cent.	
0	.49	.....	

Elongation of inch sections, ".08, ".13, ".28*.

Diameter at fracture, ".42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

Appearance of fracture, silky, trace of granulation.

No. 7685.

Cammell toughened steel, 1872.
 Marks, 345, Rail 41.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0008	0.		
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0082	0.		
35,000	.0088	.....	
40,000	.0045	.0001		Elastic limit.
45,000	.0051	.....	
46,000	.0056	.....	
47,000	.0060	.....	
48,000	.0067	.....	
49,000	.0076	.....	
50,000	.0084	.0029		
52,000	.0101	.....	
54,000	.0120	.....	
56,000	.0154	.....	
58,000	.0190	.....	
60,000	.0230	.0161	Tensile strength. = 6.3 per cent.	
64,000	.03	.....	
68,000	.04	.....	
72,000	.06	.....	
75,000	.09	.....	
80,000	.12	.....	
84,000	.15	.....	
87,200	.....	.....
0	.19	.....	

Elongation of inch sections, ".07*", ".07, ".05.
 Diameter at fracture, ".54; area, .2290 square inch.
 Contraction of area, 8.4 per cent.
 Appearance of fracture, granular, radiating from a point in the circumference opposite the top surface of head of rail.

No. 7739.

Sheffield Atlas steel.
 Marks, 347, Rail 47.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	0.	
35,000	.0036	0.	
40,000	.0041	0.	
45,000	.0048	.0001	Elastic limit.
50,000	.0055	.0002	
51,000	.0057	.....
52,000	.0061	.....
53,000	.0071	.....
54,000	.0099	.....
55,000	.0117	.0064	
56,000	.0135	.....
57,000	.0154	.....
58,000	.0170	.....
59,000	.0180	.....
60,000	.0200	.0130	
62,000	.0245	.....
64,000	.0288	.....
66,000	.0340	.....
68,000	.0392	.....
70,000	.0450	.0261	
72,000	.05	.....
76,000	.06	.....
80,000	.08	.....
84,000	.09	.....
88,000	.10	.....
92,000	.12	.....
96,000	.14	.....
100,000	.18	.....
104,000	.24	.....
106,800	.....	.....	Tensile strength.
0	.62	.....	= 17.3 per cent.

Elongation of inch sections, ".20, ".21*, ".11.

Diameter at fracture, ".48; area, .1810 square inch.

Contraction of area, 27.6 per cent.

Appearance of fracture, fine granular, radiating from a point near center.

Landore Siemens steel, 11.73.
 Marks, 349, Rail 51.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0031	.0001	
35,000	.0040	.0006	Elastic limit.
36,000	.0046	.....
37,000	.0049	.....
38,000	.0052	.....
39,000	.0058	.....
40,000	.0061	.0016	
41,000	.0067	.....
42,000	.0070	.....
43,000	.0078	.....
44,000	.0090	.....
45,000	.0098	.0042	
46,000	.0106	.....
47,000	.0119	.....
48,000	.0130	.....
49,000	.0148	.....
50,000	.0172	.0113	
52,000	.0198	.....
54,000	.0247	.....
56,000	.0303	.....
58,000	.0351	.....
60,000	.0400	.0319	
64,000	.0515	.....
68,000	.0650	.....
72,000	.0805	.0707	
76,000	.10	.....
80,000	.12	.....
84,000	.16	.....
88,000	.20	.....
92,000	.30	.....
98,600	.....	.....	Tensile strength.
0	.58	.....	=19.3 per cent.

Elongation of inch sections, ".16, ".26*, ".16.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Appearance of fracture, fine silky, radiating from a silky spot at circumference. Lines of lighter-colored metal on opposite sides of the stem. Short, transverse cracks developed along these lines.

No. 7732.

Wilson Cammell Dowlais steel. 10.70 guaranteed.
 Marks, 351, Rail 52.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
1,000	0.	0.	Initial load.	
5,000	.0008	0.		
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	0.		
35,000	.0034	0.		
40,000	.0040	0.		
45,000	.0046	.0001		
48,000	.0050	.....	
49,000	.0052		Elastic limit.
50,000	.0056	.0006		
51,000	.0059	.....	
52,000	.0061	.....	
58,000	.0064		Tensile strength. =0.7 per cent.
54,000	.0068	.....	
55,000	.....	.....
0	.02	.....	

Elongation of inch sections, ".01, ".00, ".01*.

Contraction of area, inappreciable.

Appearance of fracture, fine granular, radiating from a point at the circumference where a dark-colored spot ".35 by ".15 existed. This dark-colored section has the same character of surface as the remaining part of the fracture, and is thought to represent a crack which was occasioned by the hammer while straightening the ends of the endurance shaft after the latter had been rough turned.

No. 7749.

Wilson Cammell Dowlais steel, 10.70 guaranteed.
 Marks 351, Rail 52, second sample.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	
20,000	.0019	
30,000	.0029	0.	Elastic limit.
40,000	.0042	.0002	
41,000	.0045	.....
42,000	.0048	.....
43,000	.0050	.....
44,000	.0052	.....
45,000	.0057	.0011	
46,000	.0066	.....
47,000	.0072	.....
48,000	.0079	.....
49,000	.0088	.....
50,000	.0101	.0050	
52,000	.0122	.....
54,000	.0150	.....
56,000	.0185	.....
58,000	.0228	.....
60,000	.0265	.0200	
64,000	.04	.....
68,000	.06	.....
72,000	.06	.....
76,000	.08	.....
80,000	.10	.....
84,000	.12	.....
88,000	.15	.....
92,000	.19	.....
96,000	.26	.....
97,600	Tensile strength.
0	.43	= 14.3 per cent.

Elongation of inch sections, ".08, ".23*, ".12.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Appearance of fracture, fine granular, radiating from a point in the circumference.

No. 7733.

28 P. S. Co. 85.
 Marks, 361, Rail 56.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	0.	
20,000	.0019	0.	
30,000	.0030	0.	
35,000	.0036	0.	
40,000	.0041	0.	
45,000	.0047	.0001	
48,000	.0050	.....	Elastic limit.
49,000	.0054	.....	•
50,000	.0059	.0007	
51,000	.0062	.....
52,000	.0066	.....
58,000	.0070	.....
54,000	.0077	.....
55,000	.0088	.0027	
56,000	.0096	.....
57,000	.0101	.....
58,000	.0118	.....
59,000	.0127	.....
60,000	.0147	.0075	
62,000	.0172	.....
64,000	.0206	.....
66,000	.0240	.....
68,000	.0288	.....
70,000	.0338	.0250	
76,000	.04	.....
80,000	.05	.....
84,000	.06	.....
88,000	.07	.....
92,000	.08	.....
96,000	.10	.....
100,000	.12	.....
104,000	.14	.....
108,000	.17	.....
112,000	.21	.....
115,600	.....	.....
0	.45	.....	= 15 per cent.

Elongation of inch sections, ".10, ".14, ".21*.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Appearance of fracture, granular. A longitudinal vein of less ductile metal opened short, transverse cracks along the stem in the vicinity of the fracture.

Cammell Sheffield toughened steel, 1873.

Marks, 362, Rail 60.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	0.	
35,000	.0036	0.	
40,000	.0041	.0001	Elastic limit.
41,000	.0044	.....
42,000	.0048	.....
48,000	.0062	.....
44,000	.0170	.....
45,000	.0198	.0143	
46,000	.0230	.....
47,000	.0252	.....
48,000	.0290	.....
49,000	.0320	.....
50,000	.0365	.0301	
52,000	.0423	.....
54,000	.0505	.....
56,000	.0596	.....
58,000	.0673	.....
60,000	.0794	.0706	
64,000	.10	.....
68,000	.14	.....
72,000	.18	.....
76,000	.24	.....
80,000	.37	.....
80,600	.....	.....
0	.77	.....	=25.7 per cent.

Elongation of inch sections, ".18, ".40*, ".19.

Diameter at fracture, ".41; area, .1320 square inch.

Contraction of area, 47.2 per cent.

Appearance of fracture, fine silky.

No. 7735.

Landore Siemens 2-72.
 Marks, 363, Rail 62.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
28,000	.....	.....	Elastic limit, approximate.
30,000	.0067	.0023	
31,000	.0068	.....
32,000	.0069	.....
33,000	.0096	.....
34,000	.0120	.....
35,000	.0135	.0091	
36,000	.0160	.....
37,000	.0170	.....
38,000	.0198	.....
39,000	.0220	.....
40,000	.0250	.0198	
42,000	.0800	.....
44,000	.0860	.....
46,000	.0428	.....
48,000	.0485	.....
50,000	.0557	.0488	
56,000	.08	.....
60,000	.10	.....
64,000	.18	.....
68,000	.17	.....
72,000	.23	.....
76,000	.35	.....
77,600	.....	.....	Tensile strength.
0	.75	.....	=25 per cent.

Elongation of inch sections, ".19, ".38*, ".18.
 Diameter at fracture, ".45; area, .1590 square inch.
 Contraction of area, 36.4 per cent.
 Appearance of fracture, silky.

No. 7736.

Landore Siemens, 2-72.

Marks, 364, Rail 63.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0021	.0001	Elastic limit, approximate.
21,000	.0024	.....
22,000	.0027	.....
23,000	.0029	.....
24,000	.0031	.....
25,000	.0032	.0008	
26,000	.0036	.....
27,000	.0039	.....
28,000	.0042	.....
29,000	.0047	.....
30,000	.0053	.0021	
31,000	.0062	.....
32,000	.0071	.....
33,000	.0082	.....
34,000	.0109	.....
35,000	.0118	.0077	
36,000	.0133	.....
37,000	.0150	.....
38,000	.0175	.....
39,000	.0196	.....
40,000	.0230	.0176	Rested under 1,000 pounds per square inch tension 30 minutes.
41,000	.0245	.....
42,000	.0272	.....
43,000	.0300	.....
44,000	.0328	.....
45,000	.0358	.0299	
46,000	.0378	.....
48,000	.0450	.....
50,000	.0530	.0460	
56,000	.07	.....
60,000	.09	.....
64,000	.12	.....
68,000	.16	.....
72,000	.21	.....
76,000	.31	.....
78,640	.....	.....	Tensile strength.
0	.78	.....	=26 per cent.

Elongation of inch sections, ".20, ".40*, ".18.

Diameter at fracture, ".42; area, .1385 square inch.

Contraction of area, 44.6 per cent.

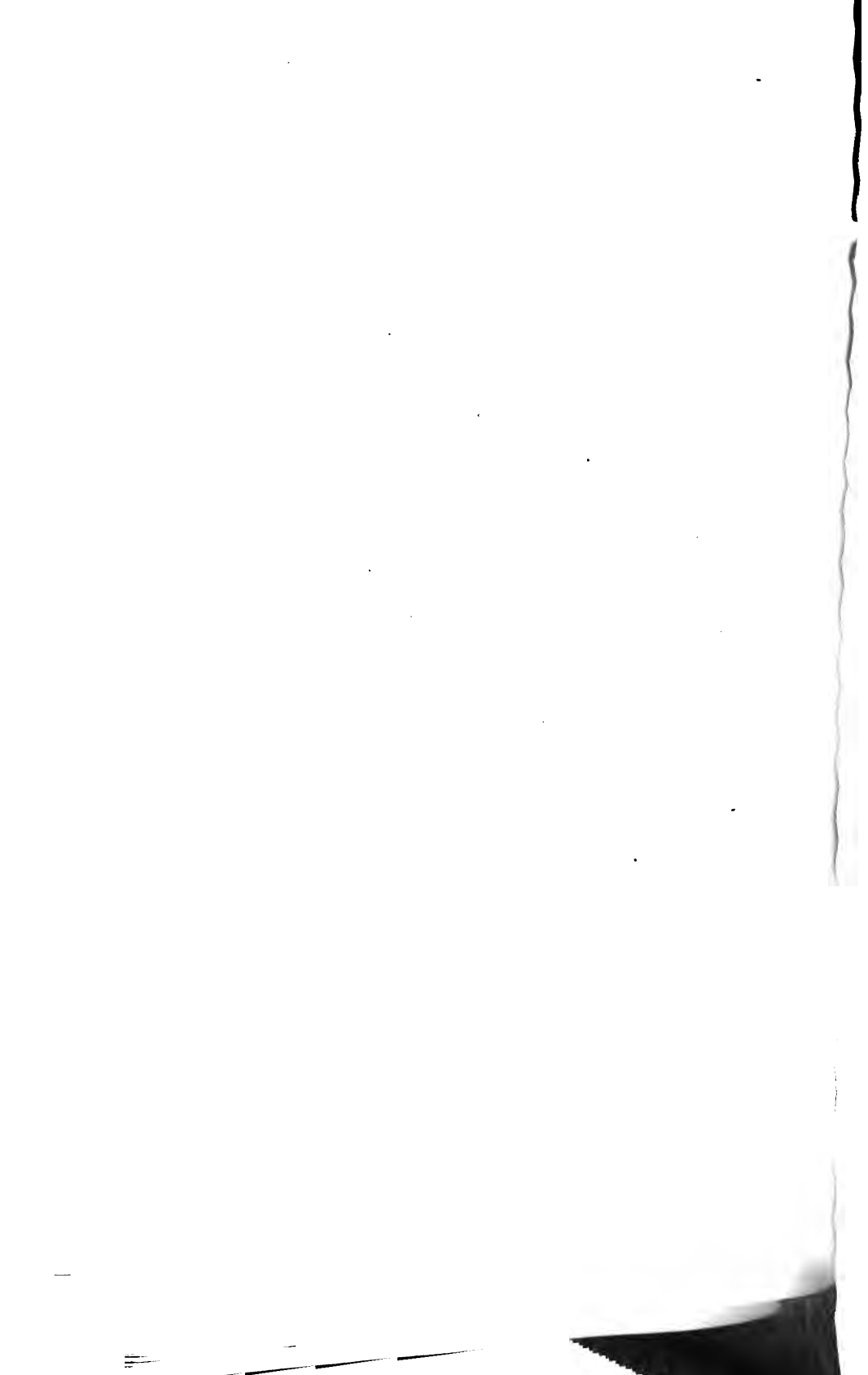
Appearance of fracture, silky.

TABULATION OF TENSION SPECIMENS FROM ENDS OF BARS RUPTURED BY ENDURANCE TESTS OF ROTATING SHAFTS.

METAL FROM HEADS OF OLD STEEL RAILS.
SECTION AREA, .25 SQUARE INCH; GAUGED LENGTH, 3".

Tension test number.	Endurance test number.	Description.	Carbon.	Nickel.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
7725	844	Cammell steel, 1872, toughened.	Per cent.	Per cent.	Pounds.	Pounds.	Per cent.	Per cent.	" "	" "
7685	845	.....do.....	.....	.....	a 47,000 45,000	85,040 87,200	16.8 6.3	44.6 8.4	.08, .13, .28* .07*, .07, .06	Silky, trace of granulation. Granular, radiating from point in circumference.
7729	847	Sheffield Atlas steel	.53	.....	50,000	106,800	17.3	27.6	.20, .21*, .11	Fine granular, radiating from point near center.
7730	848	Petilm Gaudet	.41	.....	45,000	94,640	17.3	30.6	.10, .21*, .21*	Fine granular, radiating from silky spot at circumference.
7731	849	Landore Siemens steel, 11.73	.41	.....	35,000	93,600	19.3	24.6	.16, .26*, .16	Fine granular, radiating from silky spot at circumference.
7732	851	Wilson Cammell Dowials steel, 10.70.	.50	.....	49,000	56,000	0.7	(b)	.01, .00, .01*	Fine granular, radiating from dark spot at circumference.
7749	351	Wilson Cammell Dowials steel, 10.70 (second sample).	.50	.....	40,000	97,600	14.3	24.6	.06, .23*, .12	Fine granular, radiating from point at circumference.
7733	361	28 P. S. Co., 85	.46	.....	48,000	115,600	15.0	24.6	.10, .14, .21*	Granular, short, transverse cracks in stem.
7734	362	Cammell Sheffield toughened steel, 1878.	.39	.....	40,000	80,600	25.7	47.2	.18, .40*, .19	Fine silky.
7735	363	Landore Siemens, 2-72	.51	.....	a 28,000	77,600	25.0	36.4	.19, .38*, .18	Silky.
7736	364	.....do.....	.44	.....	a 20,000	78,640	-6.0	44.6	.20, .40*, .18	Do.

a Approximate. b Inappreciable.



**RETESTS OF OVERSTRAINED STEEL AND
IRON BARS.**



No. 2765.

Midvale steel bar marked ^{SB3}_{L1M} Second specimen.

(See Tests of Metals, 1889, page 316, and 1890, page 695, for previous tests of this bar.)

Retested after interval of rest of 14 years 5 months.

Diameter of stem taken at 3", as in last test.

Sectional area, 7.068 square inches.

Micromometer set at ".1442, the reading when earlier test was discontinued.

Original gauged length, 10".

Applied loads.		Under tensile stress.		Under compressive stress.		Remarks.
Total.	Per square inch.	Elongation.	Permanent set.	Compression.	Permanent set.	
Pounds.	Pounds.	Inch.	Inch.	Inch.	Inch.	
0	0		.1442		-.1442	
35,340	5,000			-.1433		
70,680	10,000			-.1417	-.1444	
106,020	15,000			-.1403		
141,360	20,000			-.1386	-.1444	
176,700	25,000			-.1371		
212,040	30,000			-.1354	-.1444	
247,380	35,000			-.1339		
282,720	40,000			-.1309	-.1434	
318,060	45,000			-.1261		
353,400	50,000			-.1150	-.1310	
	5,000	.1322				
	10,000	.1342	.1313			
	15,000	.1363	.1317			
	20,000	.1384	.1321			
	20,000			-.1252	-.1319	
	20,000	.1384				
	25,000	.1407	.1326			
	30,000	.1434	.1334			
	30,000			-.1229	-.1323	
	30,000	.1434				
	35,000	.1462	.1343			
	40,000	.1500	.1361			
	20,000			-.1289	-.1355	
	30,000			-.1251	-.1349	
	40,000			-.1204	-.1335	
	40,000	.1500	.1360			
	45,000	.1536	.1379			
	50,000	.1587	.1407			
	5,000			-.1390	.1405	
	15,000			-.1352	-.1400	
	20,000			-.1332	-.1395	
	5,000			-.1380	-.1395	
	5,000	.1413	.1395			
	10,000			-.1364	-.1395	
	10,000	.1432	.1395			
	15,000			-.1348	-.1395	
	15,000	.1449	.1395			
	20,000			-.1330	-.1393	
	20,000	.1465	.1394			
	25,000			-.1306	-.1389	
	25,000	.1479	.1390			
	30,000			-.1281	-.1379	
	30,000	.1489	.1384			
	35,000			-.1252	-.1368	
	35,000	.1502	.1379			
	40,000			-.1217	-.1350	
	40,000	.1518	.1377			
	45,000			-.1164	-.1317	
	45,000	.1540	.1379			
	50,000			-.1072	-.1241	
	50,000	.1571	.1386			
	5,000			-.1369	-.1382	
	10,000			-.1349	-.1379	
	15,000			-.1328	-.1374	
	20,000			-.1306	-.1370	
	25,000			-.1270	-.1361	
	30,000			-.1251	-.1350	
	35,000			-.1219	-.1331	
	40,000			-.1177	-.1311	

No. 2765—Continued.

Applied loads.		Under tensile stress.		Under compressive stress.		Remarks.
Total.	Per square inch.	Elongation.	Permanent set.	Compression.	Permanent set.	
Pounds.	Pounds.	Inch.	Inch.	Inch.	Inch.	
.....	45,000	.....	.....	— .1129	— .1278	
.....	50,000	.....	.....	— .1054	— .1220	
.....	5,000	.1232	.1222	.....	.....
.....	10,000	.1254	.1226	.....	.....
.....	15,000	.1276	.1230	.....	.....
.....	20,000	.1301	.1237	.....	.....
.....	25,000	.1326	.1244	.....	.....
.....	30,000	.1356	.1256	.....	.....
.....	35,000	.1391	.1270	.....	.....
.....	40,000	.1434	.1293	.....	.....
.....	45,000	.1486	.1324	.....	.....
.....	50,000	.1556	.1370	.....	.....
.....	50,000	.1560	.1377	.....	.....
.....	50,000	.1561	.1380	.....	.....
.....	50,000	.1563	.1381	.....	.....
.....	50,000	.....	.....	— .1015	— .1179	
.....	50,000	.....	.....	— .1015	— .1177	

Test discontinued. Set aside for another interval of rest.

TENSION TESTS.

DOUBLE REFINED WROUGHT IRON FROM ELMIRA IRON AND STEEL ROLLING MILL COMPANY.

No. 7548.

Retest of tensile specimen after interval of 20 years 4 months. End of fractured tensile specimen turned down from 2-inch round bar to dimensions given below. (For original test of this metal see Tests of Metals, 1882, p. 197.)

Marks, L 209.

Diameter, 1".129.

Sectional area, 1 square inch.

Gauged length, 20". Stem 21" long.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	Inch.	Inch.	Initial load.
1,000	0.	0.	
5,000	.0030	0.	
10,000	.0067	.0001	
20,000	.0139	— .0003	
30,000	.0212	— .0003	
35,000	.0252	— .0004	
40,000	.0286	— .0004	
45,000	.0325	— .0004	
50,000	.0361	— .0004	
55,000	.0400	— .0004	
10,000	.0066	.....
20,000	.0140	.....
30,000	.0214	.....
40,000	.0286	.....
50,000	.0361	.....
40,000	.0289	.....
30,000	.0215	.....
20,000	.0141	.....
10,000	.0066	— .0004	Test discontinued.

DOUBLE REFINED WROUGHT IRON FROM THE PASSAIC ROLLING MILL COMPANY.

No. 7549.

Retest of tensile specimen after interval of 20 years 4 months. End of fractured tensile specimen turned down from 2-inch round bar to dimensions given below. (For original test of this metal see Tests of Metals, 1882, page 191.)

Marks, S 219.

Diameter, 1".129.

Sectional area, 1 square inch.

Gauged length, 20". Stem, 21" long.

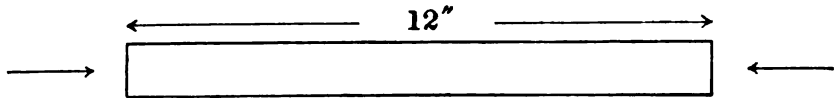
Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0029	0.	
10,000	.0066	0.	
20,000	.0139	— .0001	
30,000	.0209	— .0001	
35,000	.0246	— .0002	
40,000	.0282	— .0002	
45,000	.0316	— .0002	
50,000	.0352	— .0002	
55,000	.0389	— .0003	
10,000	.0066	.....
20,000	.0139	.....
30,000	.0209	.....
40,000	.0282	.....
50,000	.0351	.....
40,000	.0283	.....
30,000	.0210	.....
20,000	.0139	.....
10,000	.0066	— .0002	Test discontinued.

COMPRESSION TEST.

DOUBLE REFINED WROUGHT IRON FROM THE PASSAIC ROLLING MILL COMPANY.

No. 1182.

Specimen turned down from a fractured tensile specimen. Original test made 20 years 4 months prior to the present test.



Marks, S-219.

Diameter, 1".129.

Sectional area, 1 square inch.

Gauged length, 10".

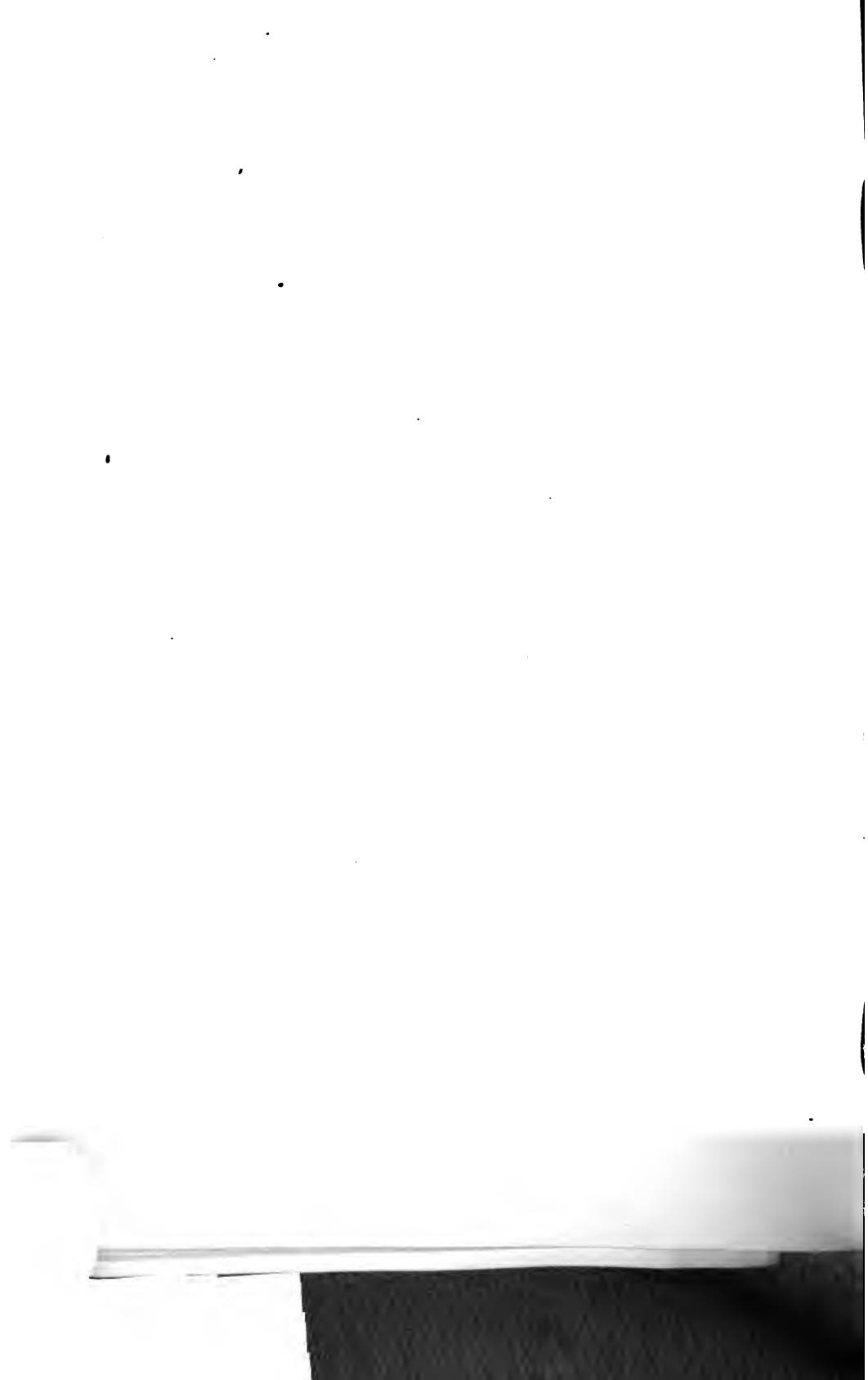
Applied loads per square inch.	In gauged length.		Remarks.
	Compression.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0014	0.	
10,000	.0081	0.	
15,000	.0048	0.	
20,000	.0065	0.	
25,000	.0083	0.	
30,000	.0101	0.	
35,000	.0118	0.	
40,000	.0137	.0001	
45,000	.0157	.0004	
50,000	.0186	.0015	
55,000	.0241	.0051	
60,000	.0391	.0182	
61,500	.....	.....		Ultimate strength.

Failed by triple flexure.

Bent 160° and then fractured.

Appearance of fracture, fibrous 45 per cent on the tension side of the bend, granular 55 per cent on the compression side of the bend.

NICKEL STEEL.



NICKEL STEEL.

SPECIMENS FROM A BILLET CONTRIBUTED BY THE CARBON STEEL COMPANY, PITTSBURG, PA.

Percentage of nickel, 30 per cent. Billets drawn down in the Arsenal smith shop and bars tested in the natural state and after heating and quenching at different temperatures.

No. 7710.

Heated cherry red and quenched in brine.

Marks, 30 Ni-1.

Diameter, ".562.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	.0001	
10,000	.0014	0.	
15,000	.0019	.0001	Elastic limit.
16,000	.0021	.....
17,000	.0023	.....
18,000	.0027	.....
19,000	.0030	.....
20,000	.0034	.0010	
21,000	.0039	.....
22,000	.0048	.....
23,000	.0054	.....
24,000	.0067	.....
25,000	.0085	.0052	
26,000	.0120	.....
27,000	.0148	.....
28,000	.0224	.....
29,000	.0272	.....
30,000	.0378	.0039	
31,000	.0422	.....
32,000	.0565	.....
33,000	.0615	.....
34,000	.0720	.....
35,000	.0808	.0765	
36,000	.0915	.....
38,000	.1138	.....
40,000	.1375	.1315	
42,000	.15	.....
44,000	.18	.....
48,000	.25	.....
52,000	.33	.....
56,000	.42	.....
60,000	.54	.....
64,000	.74	.....
65,680	.....	.....	Tensile strength.
0	1.29	.....	= 43 per cent.

Elongation of inch sections, ".31, ".67*, ".31.

Diameter at fracture, ".28; area, .0616 square inch.

Contraction of area, 75.4 per cent.

Appearance of fracture, silky.

Heated cherry red and quenched in oil.
 Marks, 30 Ni-2.
 Diameter, ".562.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0011	0.	
15,000	.0020	.0001	Elastic limit.
16,000	.0022	.....
17,000	.0026	.....
18,000	.0029	.....
19,000	.0038	.....
20,000	.0041	.0014	
21,000	.0048	.....
22,000	.0068	.....
23,000	.0087	.....
24,000	.0131	.....
25,000	.0198	.0164	
26,000	.0298	.....
27,000	.0390	.....
28,000	.0490	.....
29,000	.0647	.....
30,000	.0665	.0622	
31,000	.0710	.....
32,000	.0868	.....
33,000	.0920	.....
34,000	.1045	.....
35,000	.1135	.1083	
36,000	.1252	.....
38,000	.1521	.....
40,000	.1750	.1683	
42,000	.19	.....
44,000	.23	.....
46,000	.26	.....
48,000	.29	.....
50,000	.33	.....
52,000	.37	.....
54,000	.42	.....
56,000	.46	.....
58,000	.52	.....
60,000	.60	.....
62,000	.69	.....
64,000	.85	.....
64,800	.....	.....	Tensile strength.
0	1.33	.....	= 44.3 per cent.

Elongation of inch sections, ".33, ".68*, ".32.
 Diameter at fracture, ".28; area, .0616 square inch.
 Contraction of area, 75.4 per cent.
 Appearance of fracture, silky.

No. 7712.

Heated to a bright yellow and quenched in brine.
 Marks, 30 Ni-3.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	0.	
15,000	.0017	0.	
16,000	.0020		Elastic limit.
17,000	.0022		
18,000	.0025		
19,000	.0028		
20,000	.0032	.0008	
21,000	.0038		
22,000	.0046		
23,000	.0054		
24,000	.0066		
25,000	.0079	.0048	
26,000	.0099		
27,000	.0141		
28,000	.0200		
29,000	.0260		
30,000	.0377	.0335	
32,000	.0565		
34,000	.0750		
36,000	.0950		
38,000	.1210		
40,000	.1415	.1353	
42,000	.20		
43,000	.26		
44,000	.34		
45,000	.43		
46,000	.56		
47,000	.76		
0	1.28		Tensile strength. =42.7 per cent.

Elongation of inch sections, ".32, ".65*, ".31.
 Diameter at fracture, ".30; area, .0707 square inch.
 Contraction of area, 71.7 per cent.
 Appearance of fracture, silky.

No. 7713.

Heated to a bright yellow and quenched in oil.

Marks, 30 Ni-4.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
15,000	.0019	0.	
16,000	.0021	.....	Elastic limit.
17,000	.0023	.....
18,000	.0028	.....
19,000	.0081	.....
20,000	.0087	.0010	
21,000	.0041	.....
22,000	.0064	.....
23,000	.0069	.....
24,000	.0086	.....
25,000	.0160	.0128	
26,000	.0232	.....
27,000	.0310	.....
28,000	.0425	.....
29,000	.0500	.....
30,000	.0628	.0685	
32,000	.0605	.....
34,000	.1000	.....
36,000	.1210	.....
38,000	.1450	.....
40,000	.1685	.1620	
44,000	.22	.....
48,000	.29	.....
52,000	.36	.....
56,000	.45	.....
60,000	.57	.....
64,000	.80	.....
65,600	.....	.....	Tensile strength.
0	1.81	.....	=48.7 per cent.

Elongation of inch sections, ".30, ".67*, ".34.

Diameter at fracture, ".30; area, .0707 square inch.

Contraction of area, 71.7 per cent.

Appearance of fracture, silky.

No. 7714.

Heated white hot and quenched in brine.
 Marks, 30 Ni-5.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0009	0.	
15,000	.0017	.0001	
16,000	.0020	.....	Elastic limit.
17,000	.0022	.....
18,000	.0026	.....
19,000	.0029	.....
20,000	.0032	.0010	
21,000	.0038	.....
22,000	.0042	.....
23,000	.0049	.....
24,000	.0059	.....
25,000	.0070	.0040	
26,000	.0096	.....
27,000	.0122	.....
28,000	.0187	.....
29,000	.0243	.....
30,000	.0370	.0390	
32,000	.0662	.....
34,000	.0780	.....
36,000	.1008	.....
38,000	.1228	.....
40,000	.1472	.1412	
44,000	.10	.....
48,000	.26	.....
52,000	.33	.....
56,000	.42	.....
60,000	.53	.....
64,000	.74	.....
65,680	.....	.....	Tensile strength.
0	1.22	.....	=40.7 per cent.

Elongation of inch sections, ".28, ".65*, ".29.
 Diameter at fracture, ".30; area, .0707 square inch.
 Contraction of area, 71.7 per cent.
 Appearance of fracture, silky.

Heated white hot and quenched in oil.
 Marks, 30 Ni-6.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0006	0.	
10,000	.0012	.0001	
15,000	.0021	.0002	
16,000	.0023	.....	Elastic limit.
17,000	.0026	.....
18,000	.0030	.....
19,000	.0032	.....
20,000	.0039	.0014	
21,000	.0047	.....
22,000	.0068	.....
23,000	.0084	.....
24,000	.0127	.....
25,000	.0200	.0169	
26,000	.0343	.....
27,000	.0430	.....
28,000	.0579	.....
29,000	.0620	.....
30,000	.0773	.0732	
32,000	.0980	.....
34,000	.1200	.....
36,000	.1420	.....
38,000	.1720	.....
40,000	.2000	.1937	
44,000	.26	.....
48,000	.33	.....
52,000	.41	.....
56,000	.51	.....
60,000	.67	.....
63,680	.....	.....	Tensile strength.
0	1.30	.....	= 43.3 per cent.

Elongation of inch sections, ".30, ".69*, ".31.
 Diameter at fracture, ".29; area, .0661 square inch.
 Contraction of area, 73.6 per cent.
 Appearance of fracture, silky.

No. 7716.

Natural state.
 Marks, 30 Ni.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0012	0.	
15,000	.0019	0.	
16,000	.0020	.....
17,000	.0022	.....
18,000	.0024	.....
19,000	.0026	.....
20,000	.0028	.0002	
21,000	.0029	.....
22,000	.0031	.....	Elastic limit
23,000	.0034	.....
24,000	.0039	.....
25,000	.0044	.0012	
26,000	.0066	.....
27,000	.0069	.....
28,000	.0106	.....
29,000	.0143	.....
30,000	.0222	.0185	
32,000	.0858	.....
34,000	.0890	.....
36,000	.0758	.....
38,000	.0970	.....
40,000	.1172	.1112	
44,000	.17	.....
48,000	.22	.....
52,000	.28	.....
56,000	.35	.....
60,000	.45	.....
64,000	.49	.....
68,000	.90	.....	Tensile strength.
0	1.25	.....	= 41.7 per cent.

Elongation of inch sections, ".30, ".65*, ".30.
 Diameter at fracture, ".30; area, .0707 square inch.
 Contraction of area, 71.7 per cent.
 Appearance of fracture, fine silky.

TABULATION OF TENSION SPECIMENS FROM 30 PER CENT NICKEL-STEEL BILLET.

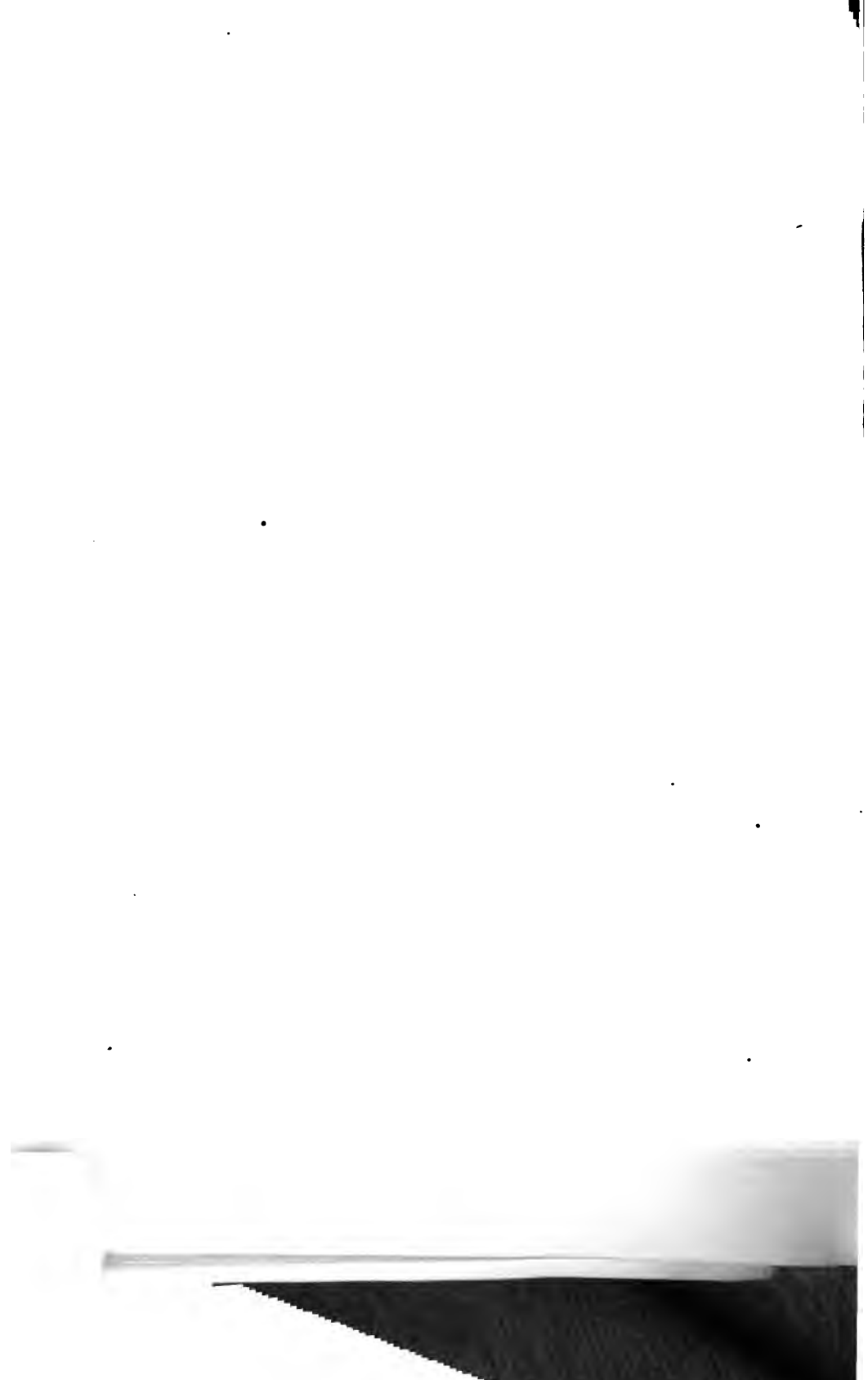
STEMS OF SPECIMENS, ".564 DIAMETER, 3" LONG.

No. of test.	Treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
7710	Heated cherry and quenched in brine.	<i>Pounds.</i> 15,000	<i>Pounds.</i> 66,680	<i>Per ct.</i> 43.0	<i>Per ct.</i> 75.4	" " " .81, .67*, .31	Silky.
7711	Heated cherry and quenched in oil.	15,000	64,800	44.3	75.4	.83, .68*, .32	Do.
7712	Heated bright yellow and quenched in brine.	17,000	65,600	42.7	71.7	.82, .65*, .31	Do.
7713	Heated bright yellow and quenched in oil.	17,000	65,600	43.7	71.7	.80, .67*, .34	Do.
7714	Heated white hot and quenched in brine.	17,000	65,680	40.7	71.7	.28, .65*, .29	Do.
7715	Heated white hot and quenched in oil.	16,000	63,680	43.3	73.6	.80, .69*, .31	Do.
7716	Natural state.	22,000	68,000	41.7	71.7	.80, .66*, .30	Do.

CHEMICAL ANALYSIS.

Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Copper.	Nickel.
.11	.56	.01	.025	.060	.000	30.3

BURDEN'S BEST IRON. PLAIN AND TWISTED BARS



FIRST SERIES.

SPECIMEN IN NATURAL STATE AND THOSE MARKED A TO F, INCLUSIVE,
TAKEN FROM THE SAME 1 1/4" SQUARE ROLLED BAR.

No. 7717.

Specimen turned down from a 1 1/4" square bar.
Natural state.
Diameter, 1".01.
Sectional area, .80 square inch.
Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	0.	
20,000	.0067	0.	
25,000	.0084	0.	
30,000	.0104	.0003	Elastic limit.
26,000	.0480	-----	Load fell.
27,000	.0607	-----	
28,000	.1470	-----	Rested under reduced load 2 minutes.
29,000	.1520	-----	
30,000	.1780	.1661	
31,000	.1950	-----	
32,000	.2280	-----	
33,000	.26	-----	
34,000	.29	-----	
35,000	.32	-----	
36,000	.36	-----	
37,000	.40	-----	
38,000	.45	-----	
39,000	.50	-----	
40,000	.55	-----	
42,000	.68	-----	
44,000	.83	-----	
46,000	1.08	-----	
48,000	1.53	-----	
49,500	-----	-----	Tensile strength.
0	2.88	-----	=28.8 per cent.

Elongation of inch sections, ".18, ".22, ".24, ".25, ".27, ".27, ".28, ".41, ".53 *, ".23.

Diameter at fracture, ".74; area, .4301 square inch.
Contraction of area, 46.2 per cent.
Appearance of fracture, fibrous.

No. 7718.

1½" square bar twisted one turn in 27". Specimen then turned down.
 Marks, A.
 Diameter, 1".009.
 Sectional area, .80 square inch.
 Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0028	0.	
10,000	.0063	0.	
20,000	.0137	.0002	
25,000	.0190	.0011	
30,000	.0240	.0036	
31,000	.0258	.....
32,000	.0270	.....
33,000	.0291	.....
34,000	.0312	.....
35,000	.0342	.0102	
36,000	.0380	.....
37,000	.0430	.....
38,000	.0465	.....
39,000	.0552	.....
40,000	.0663	.0387	
41,000	.0775	.....
42,000	.0990	.....
43,000	.1190	.....
44,000	.1525	.....
45,000	.1868	.1519	Rested 5 minutes under 45,000 pounds load, second application.
46,000	.19	.....
47,000	.20	.....
48,000	.30	.....
49,000	.37	.....
50,000	.44	.....
51,000	.52	.....
52,000	.62	.....
53,000	.74	.....
54,000	.93	.....
55,000	1.20	.....
56,000	Tensile strength.
0	2.56	=12.7 per cent.

Elongation of inch sections, ".11, ".12, ".10, ".11, ".10, ".11, ".12, ".12, ".13, ".23, ".37*, ".12, ".10, ".10, ".10, ".10, ".10, ".10, ".10, ".11, ".10.
 Diameter at fracture, ".80; area, .5027 square inch.
 Contraction of area, 37.2 per cent.
 Appearance of fracture, fibrous.

No. 7719.

1½" square bar twisted ¼ turn in 27". Specimen then turned down.
 Marks, B.
 Diameter, 1".009.
 Sectional area, .80 square inch.
 Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0028	0.	
10,000	.0060	0.	
20,000	.0188	.0008	
25,000	.0195	.0081	
30,000	.0859	.0159	
31,000	.0421	.....
32,000	.0523	.....
33,000	.0640	.....
34,000	.0822	.....
35,000	.1049	.0790	
36,000	.1200	.....
37,000	.1480	.....
38,000	.1775	.....
39,000	.2120	.....
40,000	.2460	.2142	
41,000	.26	.....
42,000	.33	.....
43,000	.37	.....
44,000	.44	.....
45,000	.50	.....
46,000	.55	.....
47,000	.65	.....
48,000	.75	.....
49,000	.88	.....
50,000	1.02	.....
51,000	1.21	.....
52,000	1.45	.....
53,000	1.86	.....
54,000	2.80	.....
0	4.06	Tensile strength. = 20.3 per cent.

Elongation of inch sections, ".15, ".17, ".18, ".18, ".18, ".19, ".17, ".16, ".18, ".19, ".17, ".20, ".28, ".53*, ".25, ".20, ".17, ".15, ".17, ".18.
 Diameter at fracture, ".75; area, .4418 square inch.
 Contraction of area, 44.8 per cent.
 Appearance of fracture, fibrous.

No. 7720.

1½" square bar twisted 1 turn in 27"; subsequently annealed by heating to a full cherry and cooling in sand. Specimen then turned down.

Marks, C.

Diameter, 1".009.

Sectional area, .80 square inch.

Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0029	0.	
10,000	.0063	0.	
20,000	.0188	.0008	
25,000	.0186	.0018	
27,000	.....	.....
25,000	.0520	.....	Elastic limit.
26,000	.0730	.....	Load fell.
27,000	.1040	.....
28,000	.1860	.....
29,000	.2210	.....
30,000	.2580	.2850	
31,000	.29	.....
32,000	.33	.....
33,000	.38	.....
34,000	.45	.....
35,000	.51	.....
36,000	.57	.....
37,000	.63	.....
38,000	.72	.....
39,000	.80	.....
40,000	.91	.....
42,000	1.18	.....
44,000	1.42	.....
45,000	1.63	.....
46,000	1.86	.....
47,000	2.17	.....
48,000	2.63	.....
49,000	3.40	.....
49,250	.....	.....	Tensile strength.
0	5.00	.....	=25 per cent.

Elongation of inch sections, ".26, ".29, ".29, ".27, ".26, ".28, ".56*, ".27, ".27, ".24, ".21, ".22, ".22, ".21, ".19, ".19, ".20, ".18, ".21, ".18.

Diameter at fracture, ".76; area, .4536 square inch.

Contraction of area, 43.3 per cent.

Appearance of fracture, fibrous.

No. 7721.

1½" square bar, twisted 1 turn in 27", then twisted back 1 turn, taking out the twist and nearly straightening the bar. Specimen then turned down.

Marks, D.

Diameter, 1".009.

Sectional area, .80 square inch.

Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0080	.0001	
10,000	.0065	.0001	
20,000	.0182	.0002	
25,000	.0170	.0007	
30,000	.0218	.0017	
31,000	.0224		
32,000	.0238		
33,000	.0242		
34,000	.0256		
35,000	.0270	.0088	
36,000	.0282		
37,000	.0298		
38,000	.0317		
39,000	.0337		
40,000	.0360	.0088	
41,000	.0387		
42,000	.0417		
43,000	.0452		
44,000	.0513		
45,000	.0588	.0270	
46,000	.0675		
47,000	.0800		
48,000	.0968		
49,000	.1220		
50,000	.1520	.1187	
51,000	.17		
52,000	.24		
53,000	.28		
54,000	.32		
55,000	.43		
56,000	.58		
57,000	.68		
58,000	.95		
58,630			Tensile strength.
0	1.97		= 9.9 per cent.

Elongation of inch sections, ".08, ".06, ".04, ".05, ".05, ".05, ".05, ".08, ".08, ".05, ".04, ".04, ".06, ".09, ".11, ".13, ".45*, ".18, ".12, ".11, ".10.

Diameter at fracture, ".76; area, .4536 square inch.

Contraction of area, 43.3 per cent.

Appearance of fracture, fibrous.

No. 7722.

1½" square bar, twisted ¼ turn in 27", then twisted back, taking out the twist and nearly straightening the bar. Specimen then turned down.

Marks, E.

Diameter, 1".009.

Sectional area, .80 square inch.

Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0030	0.	
10,000	.0062	0.	
20,000	.0132	.0002	
25,000	.0175	.0010	
30,000	.0240	.0041	
31,000	.0250	.....
32,000	.0280	.....
33,000	.0316	.....
34,000	.0351	.....
35,000	.0410	.0170	
36,000	.0480	.....
37,000	.0550	.....
38,000	.0700	.....
39,000	.0900	.....
40,000	.1190	.0892	
41,000	.1420	.....
42,000	.1700	.....
43,000	.2150	.....
44,000	.2500	.....
45,000	.2995	.2646	
46,000	.33	.....
47,000	.42	.....
48,000	.48	.....
49,000	.57	.....
50,000	.68	.....
51,000	.80	.....
52,000	.96	.....
53,000	1.18	.....
54,000	1.48	.....
55,000	2.42	.....
0	3.75	Tensile strength. =18.8 per cent.

Elongation of inch sections, ".14, ".14, ".15, ".16, ".15, ".15, ".14, ".15, ".15, ".18, ".21, ".17, ".17, ".17, ".26, ".48*, ".22, ".21, ".20, ".15.

Diameter at fracture, ".75; area, .4418 square inch.

Contraction of area, 44.8 per cent.

Appearance of fracture, fibrous.

No. 7723.

1½" square bar, twisted ½ turn in 27", then twisted back one turn, leaving the bar with a twist of one-half turn in the reverse direction from the first twist. Specimen then turned down.

Marks, F.

Diameter, 1".009.

Sectional area, .80 square inch.

Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inchs.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0028	0.	
10,000	.0061	.0001	
20,000	.0190	.0002	
25,000	.0172	.0010	
30,000	.0221	.0024	
31,000	.0235	.....
32,000	.0250	.....
33,000	.0264	.....
34,000	.0278	.....
35,000	.0292	.0063	
36,000	.0321	.....
37,000	.0347	.....
38,000	.0374	.....
39,000	.0410	.....
40,000	.0470	.0198	
41,000	.0529	.....
42,000	.0600	.....
43,000	.0700	.....
44,000	.0850	.....
45,000	.1095	.0769	
46,000	.1260	.....
47,000	.1600	.....
48,000	.1930	.....
49,000	.2300	.....
50,000	.2820	.2448	
51,000	.31	.....
52,000	.40	.....
53,000	.48	.....
54,000	.57	.....
55,000	.70	.....
56,000	.90	.....
57,000	1.41	.....
57,250	Tensile strength.
0	2.67	=13.4 per cent.

Elongation of inch sections, ".10, ".10, ".10, ".11, ".10, ".12, ".12, ".12, ".13, ".18, ".51*, ".18, ".13, ".10, ".10, ".11, ".11, ".09, ".07, ".09.

Diameter at fracture, ".74; area, .4301 square inch.

Contraction of area, 46.2 per cent.

Appearance of fracture, fibrous.

SECOND SERIES.

SPECIMENS G TO M, INCLUSIVE, TAKEN FROM A SECOND 1½" SQUARE ROLLED BAR.

No. 7761.

1½" square bar, twisted 1½ turns in 27". Specimen then turned down.

Marks, G.

Diameter, 1".009.

Sectional area, .80 square inch.

Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0029	0.	
10,000	.0064	.0001	
20,000	.0132	.0001	
25,000	.0168	.0006	
30,000	.0215	.0019	
31,000	.0224	.....
32,000	.0283	.....
33,000	.0245	.....
34,000	.0258	.....
35,000	.0271	.0043	
36,000	.0290	.....
37,000	.0304	.....
38,000	.0323	.....
39,000	.0346	.....
40,000	.0369	.0105	
41,000	.0405	.....
42,000	.0489	.....
43,000	.0480	.....
44,000	.0524	.....
45,000	.0620	.0314	
46,000	.0723	.....
47,000	.0869	.....
48,000	.1070	.....
49,000	.1300	.....
50,000	.1580	.1212	
59,250	.....	.....
0	2.24	.....
			Tensile strength. =11 per cent.

Elongation of inch sections, ".07, ".06, ".07, ".06, ".07, ".07, ".08, ".07, ".08, ".06, ".08, ".09, ".11, ".13, ".24, ".43*, ".16, ".13, ".11, ".07.

Diameter at fracture, ".75; area, .4418 square inch.

Contraction of area, 44.8 per cent.

Appearance of fracture, fibrous.

No. 7762.

1 1/4" square bar, twisted 2 turns in 27". Specimen then turned down.

Marks, H.

Diameter, 1".009.

Sectional area, .80 square inch.

Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0027	0.	
10,000	.0061	0.	
20,000	.0130	0.	
25,000	.0167	.0002	
30,000	.0206	.0010	
31,000	.0215	.....
32,000	.0223	.....
33,000	.0232	.....
34,000	.0242	.....
35,000	.0253	.0022	
36,000	.0264	.....
37,000	.0275	.....
38,000	.0287	.....
39,000	.0302	.....
40,000	.0318	.0052	
41,000	.0334	.....
42,000	.0350	.....
43,000	.0371	.....
44,000	.0396	.....
45,000	.0426	.0122	
46,000	.0460	.....
47,000	.0491	.....
48,000	.0545	.....
49,000	.0598	.....
50,000	.0688	.0336	
51,000	.0782	.....
52,000	.0910	.....
53,000	.1130	.....
54,000	.1324	.....
55,000	.1724	.1309	
56,000	.19	.....
57,000	.23	.....
58,000	.31	.....
59,000	.37	.....
60,000	.50	.....
61,000	.66	.....
62,000	1.06	.....
0	1.88	.....

Tensile strength.
= 9.4 per cent.

Load on bar at time of rupture, 40,100 pounds=88,400 pounds per square inch on area at fracture.

Elongation of inch sections, ".06, ".07, ".07, ".06, ".06, ".07, ".07, ".07, ".07, ".06, ".08, ".08, ".08, ".08, ".08, ".08, ".13, ".44*, ".11, ".09, ".05.

Diameter at fracture, ".76; area, .4536 square inch.

Contraction of area, 43.3 per cent.

Appearance of fracture, fibrous.

No. 7763.

1½" square bar, twisted 2½ turns in 27". Specimen then turned down.

Marks, I.

Diameter, 1".009.

Sectional area, .80 square inch.

Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.	
1,000	0.	0.		
5,000	.0029	0.		
10,000	.0064	0.		
20,000	.0131	0.		
25,000	.0167	.0008		
30,000	.0208	.0007		
35,000	.0252	.0016		
40,000	.0306	.0038		
41,000	.0320	.....	
42,000	.0353	.....	
43,000	.0350	.....	
44,000	.0365	.....	
45,000	.0385	.0078		
46,000	.0406	.....	
47,000	.0424	.....	
48,000	.0450	.....	
49,000	.0485	.....	
50,000	.0515	.0166		
51,000	.0557	.....	
52,000	.0606	.....	
53,000	.0672	.....	
54,000	.0760	.....	
55,000	.0898	.0494		
56,000	.1021	.....	
57,000	.1250	.....	
58,000	.1542	.....	
59,000	.1960	.1505		
60,000	.22	.....	
61,000	.31	.....	
62,000	.41	.....	
63,000	.53	.....	
63,875	.99	.....	
0	1.40	.....	
				Tensile strength. =7 per cent.

Load on bar at time of rupture, 40,200 pounds=84,140 pounds per square inch on area at fracture.

Elongation of inch sections, ".04, ".06, ".05, ".05, ".05, ".05, ".04, ".04, ".05, ".06, ".28*, ".23*, ".06, ".06, ".05, ".05, ".04, ".05, ".05, ".04.

Diameter at fracture, ".78; area, .4778 square inch.

Contraction of area, 40.3 per cent.

Appearance of fracture, fibrous.

No. 7764.

1½" square bar, twisted 3 turns in 27". Specimen then turned down.
 Marks, J.
 Diameter, 1".009.
 Sectional area, .80 square inch.
 Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.	
	Elongation.	Set.		
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.	
1,000	0.	0.		
5,000	.0080	0.		
10,000	.0064	0.		
20,000	.0184	.0002		
30,000	.0209	.0010		
35,000	.0250	.0019		
40,000	.0302	.0037		
41,000	.0314	.....	
42,000	.0326	.....	
43,000	.0339	.....	
44,000	.0353	.....	
45,000	.0369	.0068		
46,000	.0388	.....	
47,000	.0402	.....	
48,000	.0423	.....	
49,000	.0446	.....	
50,000	.0471	.0132		
51,000	.0601	.....	
52,000	.0627	.....	
53,000	.0671	.....	
54,000	.0617	.....	
55,000	.0675	.0293		
56,000	.0743	.....	
57,000	.0858	.....	
58,000	.0970	.....	
59,000	.1180	.....	
60,000	.1419	.0960		
61,000	.16	.....	
62,000	.20	.....	
63,000	.26	.....	
64,000	.35	.....	
65,000	.50	.....	
65,525	.81	.....	
0	1.37	.....	
				Tensile strength. =6.9 per cent.

Load on bar at time of rupture, 43,400 pounds = 80,210 pounds per square inch on area at fracture.

Elongation of inch sections, ".04, ".04, ".06, ".05, ".06, ".06, ".07, ".07, ".07, ".06, ".08, ".32", ".12, ".05, ".05, ".04, ".04, ".03, ".04, ".02.

Diameter at fracture, ".83; area, .5411 square inch.

Contraction of area, 32.4 per cent.

Appearance of fracture, fibrous, trace of granulation.

1½" square bar, twisted 3¼ turns in 27". Specimen then turned down.
 Marks, K.
 Diameter, 1".009.
 Sectional area, .80 square inch.
 Gauged length, 20".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0027	0.	
10,000	.0062	0.	
20,000	.0131	.0001	
30,000	.0206	.0008	
35,000	.0249	.0016	
40,000	.0297	.0030	
41,000	.0306	.....
42,000	.0317	.....
43,000	.0329	.....
44,000	.0342	.....
45,000	.0356	.0065	
46,000	.0371	.....
47,000	.0384	.....
48,000	.0400	.....
49,000	.0418	.....
50,000	.0436	.0099	
51,000	.0461	.....
52,000	.0482	.....
53,000	.0510	.....
54,000	.0535	.....
55,000	.0576	.0198	
56,000	.0616	.....
57,000	.0667	.....
58,000	.0738	.....
59,000	.0812	.....
60,000	.0920	.0495	
61,000	.10	.....
62,000	.12	.....
63,000	.14	.....
64,000	.17	.....
65,000	.25	.....
66,000	.34	.....
67,000	.56	.....
67,025	.64	.....
0	1.01	.....

Tensile strength.
= 5.1 per cent.

Load on bar at time of rupture, 39,200 pounds=74,230 pounds per square inch on area at fracture.

Elongation of inch sections, ".03, ".03, ".03, ".02, ".03, ".04, ".04, ".03, ".04, ".03, ".04, ".04, ".05, ".10, ".31*, ".06, ".04, ".03, ".04, ".02.

Diameter at fracture, ".82; area, .5281 square inch.

Contraction of area, 34 per cent.

Appearance of fracture, fibrous, trace of granulation.

No. 7766.

1½" square bar, in natural state, turned down.

Marks, M.

Diameter, 1".009.

Sectional area, .80 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0618	0.	
10,000	.0080	0.	
20,000	.0064	0.	
25,000	.0081	0.	
30,000	.0097	0.	
31,000	.0102	Elastic limit. Load fell.
32,000	.....	.....
27,000	{ .0218	.....
28,000	.0255	.....
29,000	.0297	.....
30,000	.0790	.....
30,000	.1745	.1628	
31,000	.19	.....
32,000	.21	.....
33,000	.23	.....
34,000	.26	.....
35,000	.29	.....
36,000	.33	.....
38,000	.41	.....
40,000	.49	.....
42,000	.58	.....
44,000	.72	.....
46,000	.90	.....
48,000	1.22	.....
50,000	2.00	Tensile strength. = 28.4 per cent.
0	2.84	.....

Load on bar at time of rupture, 33,400 pounds = 82,020 pounds per square inch on area at fracture.

Elongation of inch sections, ".21, ".23, ".23, ".27, ".39, ".57*, ".28, ".24, ".22, ".20.

Diameter at fracture, ".72; area, .4072 square inch.

Contraction of area, 49.1 per cent.

Appearance of fracture, fibrous.

Specimen representing the metal in a rolled bar which furnished three twisted shafts and one plain shaft for endurance tests.

No. 7767.

1½" diameter round bar, in natural state, turned down.

Marks, E.

Diameter, 1".009.

Sectional area, .80 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	0.	
20,000	.0069	.0008	
24,000	.....	.....	Elastic limit, approximate.
25,000	.0147	.0069	
26,000	.0440	.....
27,000	.0790	.1752	
28,000	.20	.....
29,000	.23	.....
30,000	.26	.....
31,000	.29	.....
32,000	.32	.....
33,000	.36	.....
34,000	.39	.....
35,000	.44	.....
36,000	.50	.....
37,000	.55	.....
38,000	.61	.....
39,000	.66	.....
40,000	.75	.....
41,000	.85	.....
42,000	.96	.....
43,000	1.10	.....
44,000	1.25	.....
45,000	1.54	.....
46,000	2.02	.....
46,275	.....	.....	Tensile strength.
0	2.88	.....	28.8 per cent.

Load on bar at time of rupture, 30,500 = 86,500 pounds per square inch on area at fracture.

Elongation of inch sections, ".22, ".22, ".23, ".23, ".21, ".23, ".30, ".69*, ".31, ".24.

Diameter at fracture, ".67; area, .3526 square inch.

Contraction of area, 55.9 per cent.

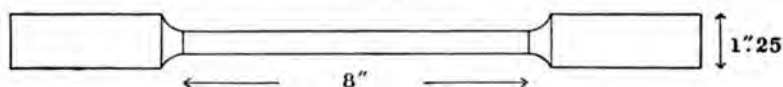
Appearance of fracture, fibrous.

FOURTH SERIES.

BURDEN'S BEST IRON.

Eight specimens taken from the same $1\frac{1}{4}$ " diameter rolled bar. Four plain specimens, four twisted specimens. Twisted about 3 turns in 27" length. Tests made on specimens $1\frac{1}{4}$ " diameter and turned to smaller diameters along the middle part.

No. 7852.



Natural state.

Diameter, ".500.

Sectional area, .196 square inch.

Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load. Elastic limit. Tensile strength. = 30 per cent elongation in 8".
1,000	0.	0.	
5,000	.0008		
10,000	.0018		
20,000	.0038		
25,000	.0050		
28,000	.0059		
29,000	.0125		
30,000	.1312		
48,120	1.26		
0	2.40		

Elongation of inch sections, ".30, ".52*, ".27, ".26, ".30, ".25, ".26, ".24.

Diameter at fracture, ".34; area, .0908 square inch.

Contraction of area, 53.7 per cent.

Fractured 1."95 from the neck.

Appearance of fracture, fibrous.

No. 7853.

Twisted bar.

Diameter, ".500.

Sectional area, .196 square inch.

Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	.....
10,000	.0020	.....
20,000	.0040	.....
25,000	.0050	.....
30,000	.0062	0.	
35,000	.0078	.....
40,000	.0086	.0002	
45,000	.0101	.0009	
50,000	.0139	.0082	
51,000	.0151	.....
52,000	.0178	.....
53,000	.0230	.....
54,000	.0340	.....
55,000	.0511	.0385	
56,000	.0794	.....
57,000	.13	.....
58,000	Tensile strength. = 6.2 per cent elongation in 8".
0	.50	.....

Load on bar at time of rupture, 8,700 pounds = 85,460 pounds per square inch on area at fracture.

Elongation of inch sections, ".03, ".03, ".04, ".02, ".03, ".02, ".03, .30*.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 48.1 per cent.

Fractured ".5 from the neck.

Appearance of fracture, fibrous.

No. 7854.

Natural state.

Diameter, ".750.

Sectional area, .442 square inch.

Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0009	Elastic limit.
10,000	.0019	.....
20,000	.0048	.....
25,000	.0061	.....
26,000	.0066	.....
27,000	.0068	.....
28,000	.0090	.....
28,000	.0340	.....
29,000	.0980	.....
30,000	.1300	.1225	
32,000	.1580	.....
34,000	.2015	.....
36,000	.26	.....
38,000	.31	.....
40,000	.38	.....
42,000	.49	.....
44,000	.68	.....
46,000	.87	.....
46,650	1.26	Tensile strength. =28 per cent elongation in 8".
0	2.24	.....

Load on bar at time of rupture, 17,100 pounds = 80,510 pounds per square inch on area at fracture.

Elongation of inch sections, ".18, ".21, ".23, ".25, ".36, ".53*, ".26, ".22.

Diameter at fracture, ".52; area, .2124 square inch.

Contraction of area, 51.9 per cent.

Fractured 4".15 from the neck.

Appearance of fracture, fibrous.

No. 7855.

Twisted bar.

Diameter, ".750.

Sectional area, .442 square inch.

Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	.....
10,000	.0019	.....
20,000	.0089	.....
25,000	.0051	.....
30,000	.0063	0.	
35,000	.0078	.....
40,000	.0095	.0008	
42,000	.0101	.....
44,000	.0112	.....
46,000	.0128	.....
48,000	.0150	.....
50,000	.0190	.0078	
52,000	.0255	.....
54,000	.0460	.....
56,000	.0880	.....
58,000	.16	.....
58,370	Tensile strength.
0	.57	=7.1 per cent elongation in 8".

Load on bar at time of rupture, 19,900 pounds=86,900 pounds per square inch on area at fracture.

Elongation of inch sections, ".03, ".04, ".04, ".03, ".03, ".03, ".04, ".33*.

Diameter at fracture, ".54; area, .2290 square inch.

Contraction of area, 48.2 per cent.

Fractured ".7 from the neck.

Appearance of fracture, fibrous.

No. 7856.

Natural state.
 Diameter, 1".
 Sectional area, .785 square inch.
 Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0005	.....
10,000	.0015	.....
20,000	.0035	.....
25,000	.0047	0.	
26,000	.0050	.....
27,000	.0052	.....	Elastic limit.
28,000	.0600	.....
29,000	.1214	.....
30,000	.1361	.1298	
32,000	.18	.....
34,000	.22	.....
36,000	.27	.....
38,000	.33	.....
40,000	.40	.....
42,000	.51	.....
44,000	.69	.....
46,000	1.08	.....
46,240	1.20	.....	Tensile strength.
0	2.34	.....	=29.2 per cent elongation in 8".

Load on bar at time of rupture, 30,800 pounds=80,040 pounds per square inch on area at fracture.

Elongation of inch sections, ".20, ".21, ".24, ".28, ".65*, ".30, ".25, ".21.

Diameter at fracture, ".70; area, .3848 square inch.

Contraction of area, 51 per cent.

Fractured 4".58 from the neck.

Appearance of fracture, fibrous, lamellar.

Diameter, 1".
 Sectional area, .785 square inch.
 Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0007	.....
10,000	.0016	.....
20,000	.0039	0.	
25,000	.0050	.....
30,000	.0060	0.	
35,000	.0072	.....
40,000	.0089	.0008	
42,000	.0092	.....
44,000	.0100	.....
46,000	.0110	.....
48,000	.0120	.....
50,000	.0133	.0027	
52,000	.0162	.....
54,000	.0178	.....
56,000	.0222	.....
58,000	.0304	.....
60,000	.0590	.....
60,380	.08	.....		Tensile strength.
0	.12	=5.7 per cent elongation in 8".
	.46	.....

Elongation of inch sections, ".01, ".02, ".01, ".01, ".03, ".33*, ".04, ".01.

Diameter at fracture, ".87; area, .5945 square inch.

Contraction of area, 24.3 per cent.

Fractured 3" from the neck.

Appearance of fracture, fibrous; opened helical cracks showing the twist of the bar. Fractured in detail.

No. 7858.

Natural state. Full section, not turned.

Diameter, 1".26.

Sectional area, 1.247 square inches.

Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0007	.....
10,000	.0018	.....
20,000	.0047	.0007	
25,000	.0058	.0007	
26,000	.0059	.....
27,000	.0060	.....	Elastic limit.
28,000	.1230	.....
29,000	.1835	.....
30,000	.1540	.1470	
32,000	.20	.....
34,000	.24	.....
36,000	.29	.....
38,000	.36	.....
40,000	.46	.....
42,000	.58	.....
44,000	.80	.....
46,000	.....	.....	Tensile strength.
0	2.74	.....	=34.2 per cent elongation in 8".

Elongation of inch sections, ".25, ".26, ".27, ".29, ".32, ".67*, ".43, ".25.

Diameter at fracture, ".87; area, .5945 square inch.

Contraction of area, 52.3 per cent.

Appearance of fracture, fibrous.

No. 7859.

Twisted bar. Full section, not turned.

Diameter, 1".26.

Sectional area, 1.247 square inches.

Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0007	.....
10,000	.0017	.....
20,000	.0039	0.	
25,000	.0050	.....
30,000	.0061	.0001	
35,000	.0073	.....
40,000	.0089	.0003	
42,000	.0096	.....
44,000	.0100	.....
46,000	.0108	.....
48,000	.0118	.....
50,000	.0130	.0020	
52,000	.0139	.....
54,000	.0152	.....
56,000	.0175	.....
58,000	.0203	.....
60,000	.0239	.0150	
62,000	.....	.....
0	.07	Tensile strength. =0.9 per cent elongation in 8".

Elongation of inch sections, ".00, ".01, ".00, ".01, ".00, ".01, ".01, ".03.

Diameter at fracture, 1".13; area, 1.0029 square inches.

Contraction of area, 19.6 per cent.

Fractured outside the gauged length.

Appearance of fracture, fibrous, irregular surface, opened helical cracks showing the twist of the bar.

TABULATION OF TENSION TESTS OF BURDEN'S BEST IRON.

PLAIN AND TWISTED BARS.

FIRST SERIES.

No. of test.	Treatment.	Elastic limit	Tensile strength	Elon-	Con-	Elevation of inch sections.	Appearance of fracture.
		per square inch.	per square inch.	ga-	tra-		
		Pounds.	Pounds.	Per ct.	Per ct.	Inch.	
7717	Natural state.....	30,000	49,500	28.8	46.2	.18, .22, .24, .25, .27, .27, .28, .41, .53*, .53.	Fibrous.
7718	Twisted 1 turn in 27".	(a)	56,000	12.7	37.2	.11, .12, .10, .11, .10, .11, .12, .12, .13, .23, .37*, .12, .10, .10, .10, .10, .10, .10, .11, .10.	Do.
7719	Twisted one-half turn in 27".	(a)	54,000	20.3	44.8	.15, .17, .18, .18, .18, .19, .17, .16, .18, .19, .17, .20, .28, .53*, .25, .20, .17, .15, .17, .18.	Do.
7720	Twisted 1 turn in 27" and annealed at full cherry.	27,000	49,250	25.0	43.3	.26, .29, .29, .27, .26, .28, .56*, .27, .27, .24, .21, .22, .22, .21, .19, .19, .20, .18, .21, .18.	Do.
7721	Twisted 1 turn in 27", then twisted back one turn, nearly straightening bar.	(a)	58,680	9.9	43.3	.06, .06, .04, .05, .05, .05, .05, .08, .08, .05, .04, .04, .06, .09, .11, .13, .45*, .18, .12, .11, .10.	Do.
7722	Twisted one-half turn in 27", then twisted back one-half turn, nearly straightening bar.	(a)	55,000	18.8	44.8	.14, .14, .15, .16, .15, .15, .14, .15, .15, .18, .21, .17, .17, .17, .26, .48, .22, .21, .20, .15.	Do.
7723	Twisted one-half turn in 27", then twisted back 1 turn, bar now having twist of one-half turn in opposite direction.	(a)	57,250	13.4	46.2	.10, .10, .10, .11, .10, .12, .12, .12, .13, .18, .51, .18, .13, .10, .10, .11, .11, .09, .07, .09.	Do.

SECOND SERIES.

7761	Twisted 1½ turns in 27".	(a)	59,250	11.2	44.8	.07, .06, .07, .06, .07, .07, .07, .08, .07, .08, .06, .08, .09, .11, .13, .24, .43*, .16, .13, .11, .07.	Fibrous.
7762	Twisted 2 turns in 27".	(a)	63,000	9.4	43.8	.06, .07, .07, .06, .06, .06, .07, .07, .07, .07, .06, .08, .08, .08, .08, .08, .13, .44*, .11, .09, .05.	Do.
7763	Twisted 2½ turns in 27".	(a)	63,875	7.0	40.3	.04, .06, .05, .05, .05, .05, .05, .04, .04, .05, .06, .06, .28*, .28*, .06, .06, .05, .05, .04, .05, .05, .04.	Do.
7764	Twisted 3 turns in 27".	(a)	65,525	6.9	32.4	.04, .04, .06, .05, .06, .06, .07, .07, .07, .06, .08, .32*, .12, .05, .05, .04, .04, .03, .04, .02.	Fibrous, trace of granulation.
7765	Twisted 3½ turns in 27".	(a)	67,025	5.1	34.0	.03, .03, .03, .02, .03, .04, .04, .03, .04, .03, .04, .04, .04, .05, .10, .31, .06, .04, .03, .04, .02.	Do.
7766	Natural state.....	32,000	50,000	28.4	49.1	.21, .23, .23, .27, .39, .57*, .28, .24, .22, .20.	Fibrous.

THIRD SERIES.

7767	Natural state.....	324,000	46,275	28.8	55.9	.22, .22, .23, .23, .21, .23, .30, .69*, .31, .24.	Fibrous.
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a Indefinite.

t Approximate.

PLAIN AND TWISTED BARS—Continued.

FOURTH SERIES.

[Turned specimens.]

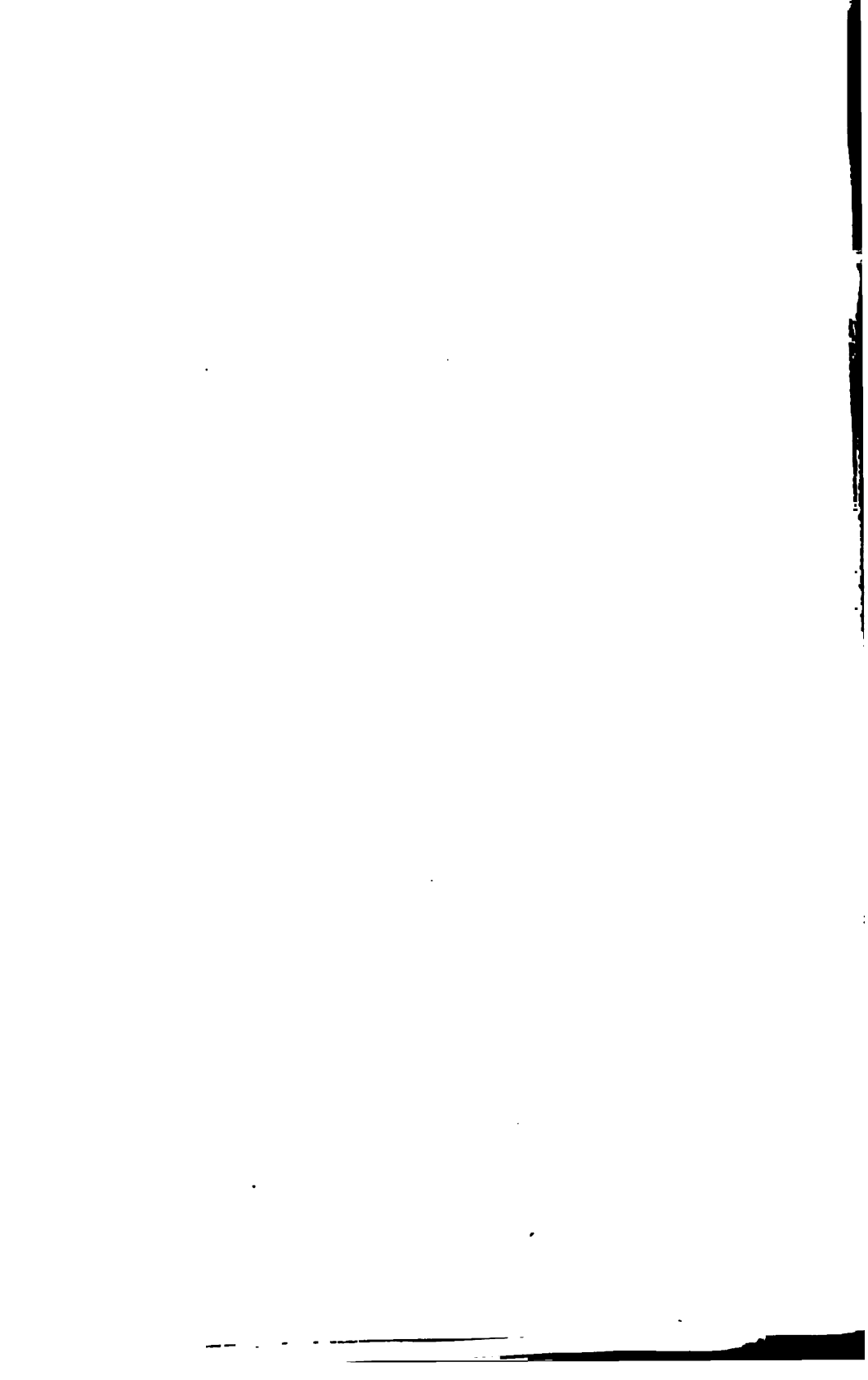
No. of test.	Treatment.	Diameter of stem.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elevation of inch sections.	Appearance of fracture.
		Inch.	Pounds.	Pounds.	Perct.	Perct.		
7852	Natural state ...	.500	28,000	48,120	30.0	53.7	<i>Inch.</i> .30, .52*, .27, .26, .30, .25, .26, .24.	Fibrous.
7853	Twisted about 3 turns in 27".	.500	(a)	58,000	6.2	48.1	.03, .08, .04, .02, .03, .02, .03, .30*	Do.
7854	Natural state ...	.750	27,000	46,650	28.0	51.9	.18, .21, .23, .25, .36, .53*, .26, .22.	Do.
7855	Twisted about 3 turns in 27".	.750	(a)	58,370	7.1	48.2	.03, .04, .04, .03, .03, .03, .04, .33*	Do.
7856	Natural state ...	1.000	27,000	46,240	29.2	51.0	.20, .21, .24, .28, .65*, .30, .25, .21.	Fibrous, lamellar.
7857	Twisted about 3 turns in 27".	1.000	(a)	60,880	5.7	24.3	.01, .02, .01, .01, .03, .33*, .04, .01.	Fibrous; opened helical cracks showing twist of bar.

[Unturned specimens.]

7858	Natural state ...	1.26	27,000	46,000	34.2	52.3	.25, .26, .27, .29, .32, .67*, .43, .25.	Fibrous.
7859	Twisted about 3 turns in 27".	1.26	(a)	62,000	0.9	19.6	.00, .01, .00, .01, .00, .01, .01, .03.	Fibrous, irregular surface; opened helical cracks showing twist of bar.

a Indefinite.

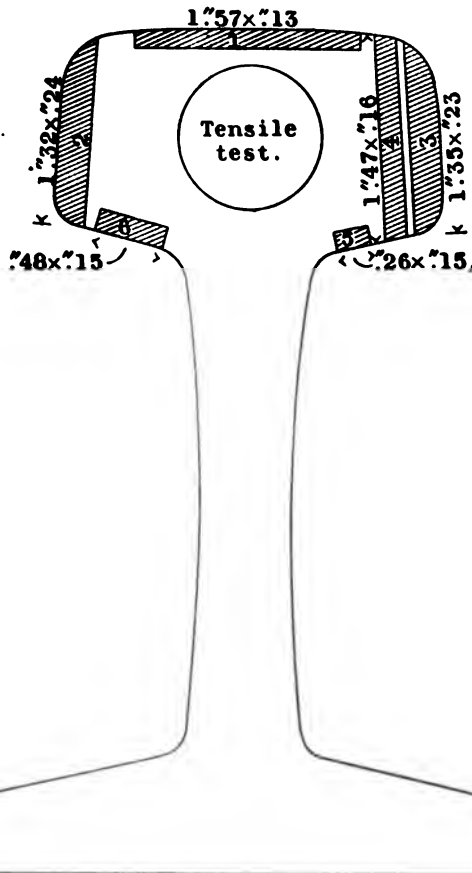
BUMPING-POST RAILS.



BUMPING POST RAILS FROM THE BOSTON TERMINAL COMPANY.

RAIL WHICH FRACTURED AUGUST, 1903, IN BUMPING POST ON TRACK
No. 2, SOUTH TERMINAL STATION, BOSTON.

RAIL ROLLED BY THE BETHLEHEM STEEL COMPANY.



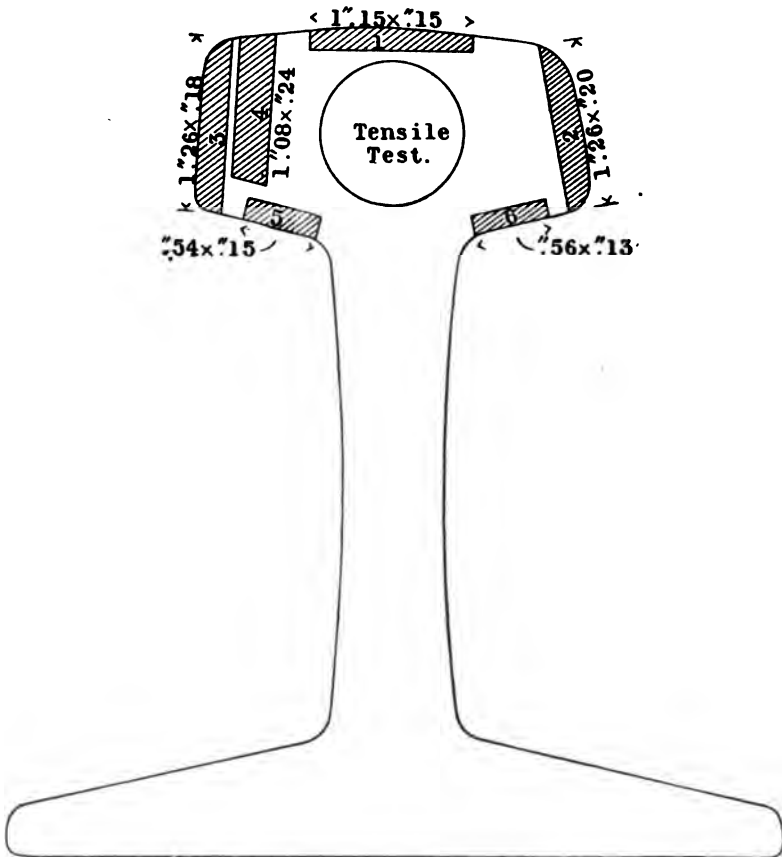
Bending strips from head of rail shown by shaded sections.

No. of strip.	Angle bent.	Radius of curvature.	Appearance of fracture.
		Inch.	
1	180	.80	Granular.
2	170	.80	Do.
3	175	.80	Do.
4	145	.9	Do.
5	142	1.	Do.
6	152	.8	Do.

All bends were made with the rolled surface of the strip on the tension side, excepting No. 4, which had the broad surface nearer the rolled surface on the tension side.

BUMPING-POST RAIL, SIMILAR TO THOSE USED IN BUMPING POSTS
AT THE SOUTH TERMINAL STATION, BOSTON.

ROLLED BY THE LACKAWANNA STEEL COMPANY.



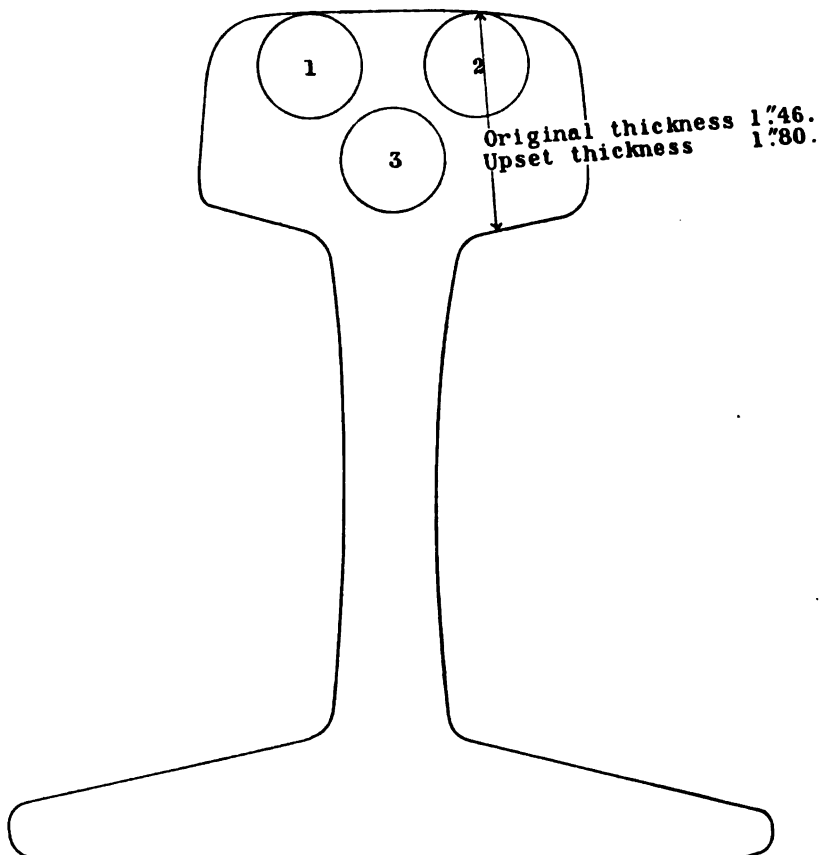
Bending strips from head of rail shown by shaded sections.

No. of strip.	Angle bent.	Radius of curvature.	Appearance of fracture.
		<i>Inches.</i>	
1	15	.....	Granular metal, with dark color immediately below the surface of the tread.
2	46	2.2	Granular; silky, lamellar at upper fillet of head of rail $\frac{1}{100}$ deep.
3	29	2.2	Granular; silky, lamellar at upper fillet of head $\frac{1}{100} \pm$ deep. A fin existed at this fillet.
4	106	1.4	Granular; metal had a dark color at the edge of strip having the original surface of the tread.
5	159	.9	Granular.
6	180	.4	Do.

REMARKS.—This piece of rail had two bolt holes through the web. The head was worn under the tread and flanges of wheels, and also showed wear on the under side of the head by splice bars. A fin was thrown over along the outside of the head.

ADDITIONAL TENSION SPECIMENS TAKEN FROM THE HEAD OF FRACTURED BUMPING-POST RAIL IN THE VICINITY OF THE PLACE OF FRACTURE.

At this place the rail head was upset to a depth of 1".80, from the original depth of 1".46, measured at the same place.



Rail rolled by the Bethlehem Steel Company. Tensile specimens from the head, Nos. 1 to 3, inclusive.

Marks.	Diameter.	Sectional area.	Tensile strength.		Elongation in 1 inch.		Diameter at fracture.	Contraction of area.	Appearance of fracture.
			Total.	Per square inch.	Inch.	P. ct.			
1.....	<i>Inch.</i> .505	<i>Sq. inch.</i> .20	<i>Pounds.</i> 23,290	<i>Pounds.</i> 116,450	<i>Inch.</i> .01	<i>P. ct.</i> 4.0	<i>Inch.</i> .49	<i>P. ct.</i> 5.7	Granular.
2.....	.505	.20	22,770	113,850	.02	2.0	.50	1.8	Granular; fractured at neck.
3.....	.505	.20	26,500	132,500	.10	10.0	.47	13.2	Granular.

No. 7849.

SPECIMEN FROM MIDDLE OF HEAD OF STEEL RAIL ROLLED BY
LACKAWANNA IRON AND STEEL COMPANY, SIMILAR TO RAILS USED
IN BUMPING POSTS AT THE SOUTH TERMINAL STATION, BOSTON.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0006	0.	
10,000	.0017	.....
20,000	.0037	.....
30,000	.0057	0.	
35,000	.0068	.....
40,000	.0078	0.	
45,000	.0088	.....
47,000	.0092	.....
48,000	.0097	.....
49,000	.0100	Elastic limit; approximate.
50,000	.0103	.0003	
51,000	.0109	.....
52,000	.0113	.....
53,000	.0120	.....
54,000	.0129	.....
55,000	.0142	.0031	
56,000	.0170	.....
57,000	.0188	.....
58,000	.0230	.....
59,000	.0256	.....
60,000	.0300	.0170	Tensile strength. = 15 per cent.
62,000	.0365	.....
64,000	.0430	.....
66,000	.0520	.....
68,000	.0608	.....
70,000	.0690	.0520	
76,000	.10	.....
80,000	.12	.....
84,000	.14	.....
88,000	.16	.....
92,000	.19	.....
96,000	.22	.....
100,000	.26	.....
104,000	.32	.....
108,000	.41	.....
112,000	.66	.....
0	.90	.....

Load on bar at time of rupture, 25,600 pounds=135,740 pounds per square inch on area at fracture.

Elongation of inch sections, ".10, ".19*, ".22*, ".15, ".13, ".11.

Diameter at fracture, ".49; area, .1886 square inch.

Contraction of area, 24.6 per cent.

Fractured 1" .3 from the neck.

Appearance of fracture, granular; silky spot at the circumference.

No. 7850.

SPECIMEN FROM MIDDLE OF HEAD OF STEEL RAIL ROLLED BY THE BETHLEHEM STEEL COMPANY.

This rail was fractured in the bumping post on track No. 2. South Terminal Station, Boston.

The specimen represents metal in the vicinity of the fracture, but not where bent to form the incline of the bumping fixture.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0018	.....
20,000	.0038	.....
30,000	.0058	0.	
35,000	.0068	.....
40,000	.0079	0.	
45,000	.0088	.....
50,000	.0100	.0001	Elastic limit, approximate.
51,000	.0103	.....
52,000	.0107	.....
53,000	.0111	.....
54,000	.0118	.....
55,000	.0126	.0013	
56,000	.0146	.....
57,000	.0165	.....
58,000	.0183	.....
59,000	.0205	.....
60,000	.0241	.0107	
62,000	.0285	.....
64,000	.0340	.....
65,000	.0397	.....
68,000	.0459	.....
70,000	.0528	.0351	
76,000	.07	.....
80,000	.09	.....
84,000	.10	.....
88,000	.12	.....
92,000	.14	.....
95,000	.16	.....
100,000	.18	.....
104,000	.20	.....
108,000	.24	.....
112,000	.28	.....
116,000	.33	.....
120,000	.41	.....
123,200	.63	.....	Tensile strength.
0	.70	.....	11.7 per cent.

Load on bar at time of fracture, 29,500 pounds = 144,400 pounds per square inch on area at fracture.

Elongation of inch sections, ".08, ".10, ".04, ".17*, ".11, ".10.

Diameter at fracture, ".51; area, .2043 square inch.

Contraction of area, 18.3 per cent.

Fractured 3".1 from the neck.

Appearance of fracture, granular.

SPECIMEN FROM THE HEAD OF SAME RAIL AS No. 7850, BUT TAKEN
REMOTE FROM THE FRACTURE.

Marks, 4.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0008	0.	Elastic limit.
10,000	.0009	.....
20,000	.0019	.....
30,000	.0028	0.	
40,000	.0039	.....
45,000	.0045	.....
50,000	.0051	0.	
51,000	.0053	.....
52,000	.0054	.....
53,000	.0055	.....
54,000	.0055	.....
55,000	.0058	.0007	
56,000	.0076	.....
57,000	.0088	.....
58,000	.0100	.....
59,000	.0113	.....
60,000	.0128	.0060	
62,000	.0155	.....
64,000	.0186	.....
66,000	.0218	.....
68,000	.0247	.....
70,000	.0281	.0191	
76,000	.04	.....
80,000	.05	.....
84,000	.06	.....
88,000	.06	.....
92,000	.07	.....
96,000	.08	.....
100,000	.10	.....
104,000	.11	.....
108,000	.12	.....
112,000	.14	.....
116,000	.18	.....
120,000	.23	.....
122,560	Tensile strength.
0	.39	=13 per cent.

Elongation of inch sections, ".15*", ".15", ".09.
Diameter at fracture, ".50; area, .1964 square inch.
Contraction of area, 21.4 per cent.
Fractured 1".1 from the neck.
Appearance of fracture, medium granular, silky near center.

No. 7875.

SPECIMEN FROM THE HEAD OF SAME RAIL AS NO. 7850, TAKEN ALONG
SIDE OF NO. 7874, REMOTE FROM THE FRACTURE.

Specimen annealed before testing.

Marks, 5.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0004	0.	
10,000	.0010	.....
20,000	.0020	.....
30,000	.0030	.....
40,000	.0042	0.	
45,000	.0047	.....
50,000	.0052	.0001	
55,000	.0057	.....
60,000	.0063	.0001	
65,000	.0069	.....
67,000	.0071	.....
68,000	.0073	.....	Elastic limit. Load fell.
66,000	.0097	.....
67,000	.0105	.....
68,000	.0151	.....
69,000	.0216	.....
70,000	.0236	.0150	
72,000	.0265	.....
74,000	.0294	.....
78,000	.0333	.....
78,000	.0364	.....
80,000	.0402	.0296	
84,000	.05	.....
88,000	.06	.....
92,000	.07	.....
96,000	.07	.....
100,000	.08	.....
104,000	.09	.....
108,000	.10	.....
112,000	.12	.....
116,000	.14	.....
120,000	.17	.....
124,000	.22	.....
126,880	.....	.....	Tensile strength.
0	.41	.....	= 13.7 per cent.

Elongation of inch sections, ".09, ".09, ".23%.

Diameter at fracture, ".47; area, .1735 square inch.

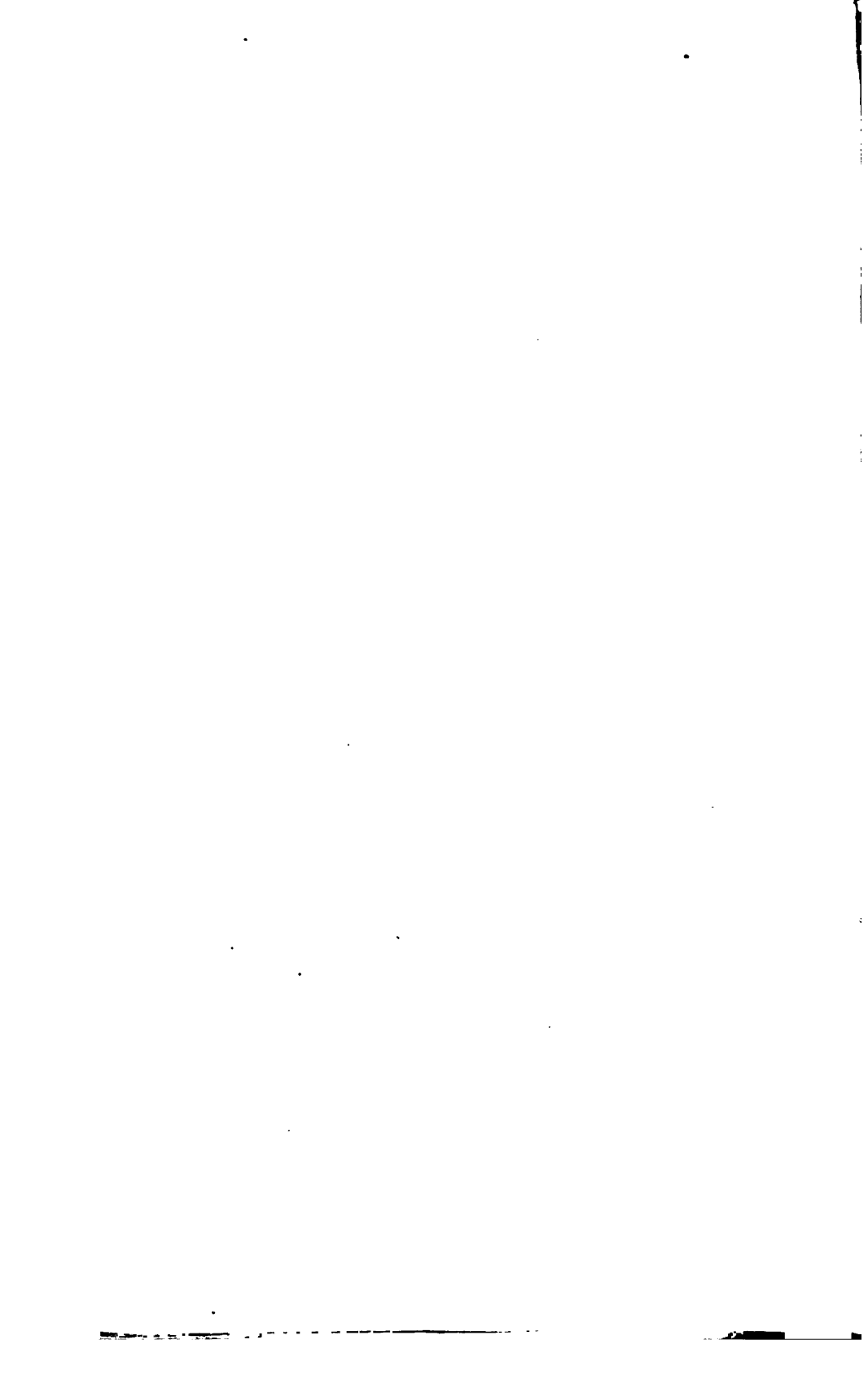
Contraction of area, 30.6 per cent.

Fractured ".65 from the neck.

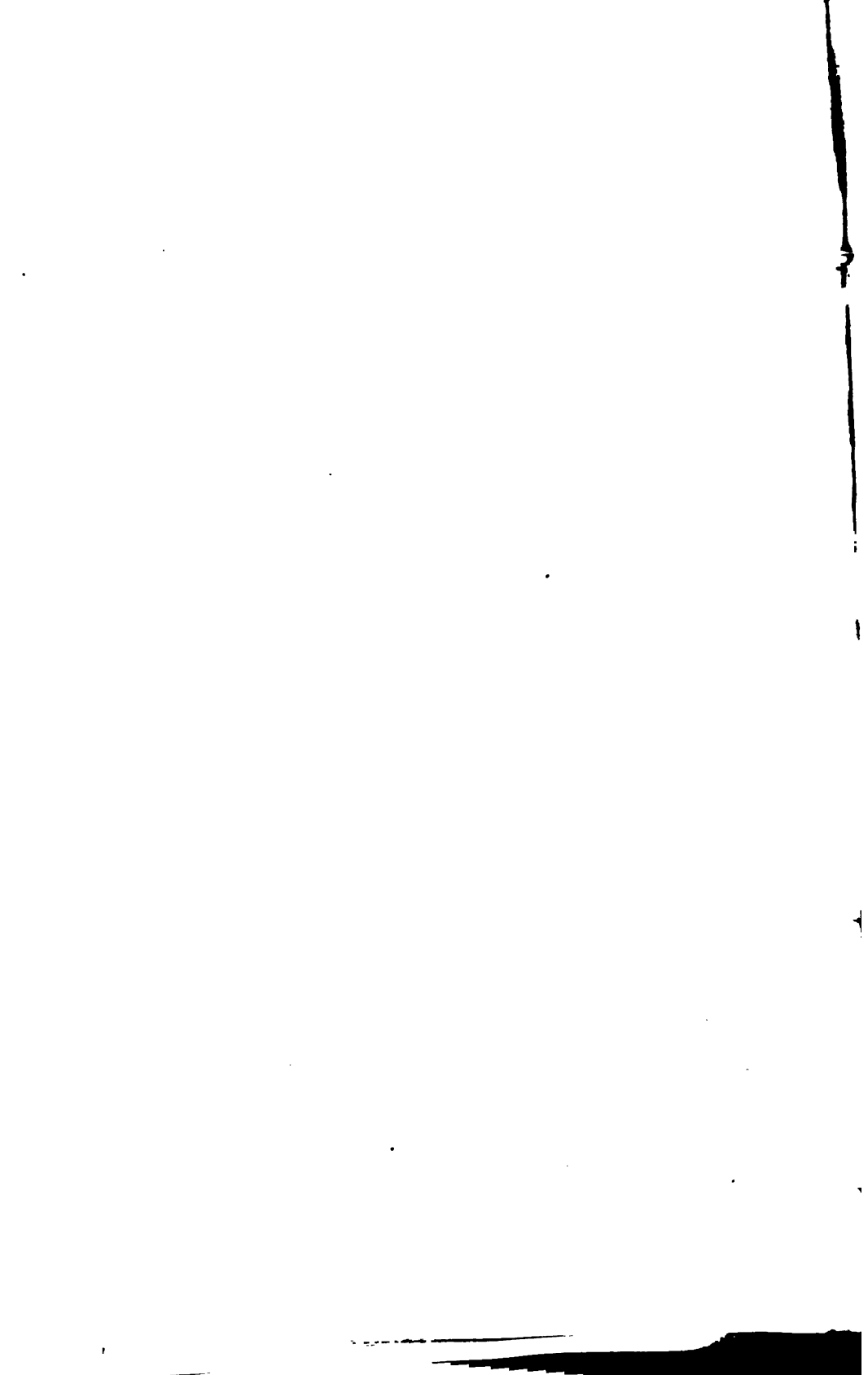
Appearance of fracture, fine granular, silky near center.

CHEMICAL ANALYSES.

Rail rolled by—	Carbon.	Manga- nese.	Silicon.	Sulphur.	Phos- phorus.
Bethlehem Steel Co.....	.71	.98	.11	.030	.050
Lackawanna Iron and Steel Co.....	.40	1.14	.12	.028	.057



STEEL RAILS.



STEEL RAILS.

MATERIAL COLLECTED AND CONTRIBUTED BY MR. P. H. DUDLEY.

DESCRIPTION.

No. 40.—Cammell toughened Sheffield steel, 1872. 4½-inch, 65-pound section. In use in main track of New York Central and Hudson River Railroad fifteen years, then used in yards. Estimated tonnage which passed over the rail, 75,000,000 tons.

No. 41.—Cammell toughened Sheffield steel, 1872. 4½-inch, 65-pound section. Service conditions same as rail No. 40.

No. 42.—Chas. Cammell toughened steel, branded "N. Y. C. & H. R. R. R." 4½-inch, 65 pound section.

No. 43.—Barrow steel, 1873 : : : : 55. 4½-inch, 65-pound section. In main line of New York Central and Hudson River Railroad fifteen years. Estimated tonnage, 85,000,000 tons.

No. 44.—Barrow steel, 1873, section 55. 4½-inch, 65-pound section. Service conditions same as No. 43.

No. 45.—John Brown & Co., Sheffield Atlas steel, 1873, section 2. 4½-inch, 65-pound section. From New York Central and Hudson River Railroad tracks. Estimated tonnage, 75,000,000 tons.

No. 46.—John Brown & Co., Sheffield Atlas steel, B/14, section 68. 4½-inch, 65-pound section. Service conditions same as rail No. 45.

No. 47.—John Brown & Co., Sheffield. 4½-inch, 65-pound section. From tracks of New York Central and Hudson River Railroad.

No. 48.—John Brown & Co., sec. 35, date, 1868. 4-inch rail. In tracks of New York Central and Hudson River Railroad thirteen years. Estimated tonnage, 65,000,000 tons.

No. 49.—Petim Gaudet | | | | | | | | | | 69. 4½-inch, 65-pound section. From tracks of New York Central and Hudson River Railroad. Estimated tonnage, 65,000,000 tons.

No. 50.—John A. Griswold steel. 4½-inch, 65-pound section. In tracks of New York Central and Hudson River Railroad fourteen years. Estimated tonnage, 75,000,000 tons.

No. 51.—Landore Siemens steel. 11.73. Naylor & Co. Sec. 68. 4½-inch, 65-pound section. From tracks of New York Central and Hudson River Railroad. Estimated tonnage, 80,000,000 tons.

No. 52.—Wilson Cammell Dowlais steel. 10.70 guaranteed. In tracks of New York Central and Hudson River Railroad eleven years.

No. 53.—Wilson Cammell steel. 4½-inch, 65-pound section. From tracks of New York Central and Hudson River Railroad.

No. 54.—"D" brand, Bethlehem, 1891. 5-inch, 75-pound section. In tracks of Mohawk and Malone Railroad nine years.

No. 55.—Carnegie Steel Company. 5½-inch, 80-pound section. In tracks of New York Central and Hudson River Railroad six months.

No. 56.—28 P. S. Co. 85. 4½-inch, 65-pound section. In tracks of New York Central and Hudson River Railroad five years.

No. 57.—Probably John Brown steel. 4½-inch, 65-pound section. From tracks of New York Central and Hudson River Railroad.

No. 58.—Head of Cammell steel rail. 4½-inch, 65-pound section.

No. 59.—Same as No. 58.

No. 60.—Cammell Sheffield toughened steel 1873. 4-inch. In tracks of Boston and Albany Railroad sixteen years.

No. 61.—John A. Griswold & Co. 1873 steel. 4-inch. In tracks of Boston and Albany Railroad sixteen years.

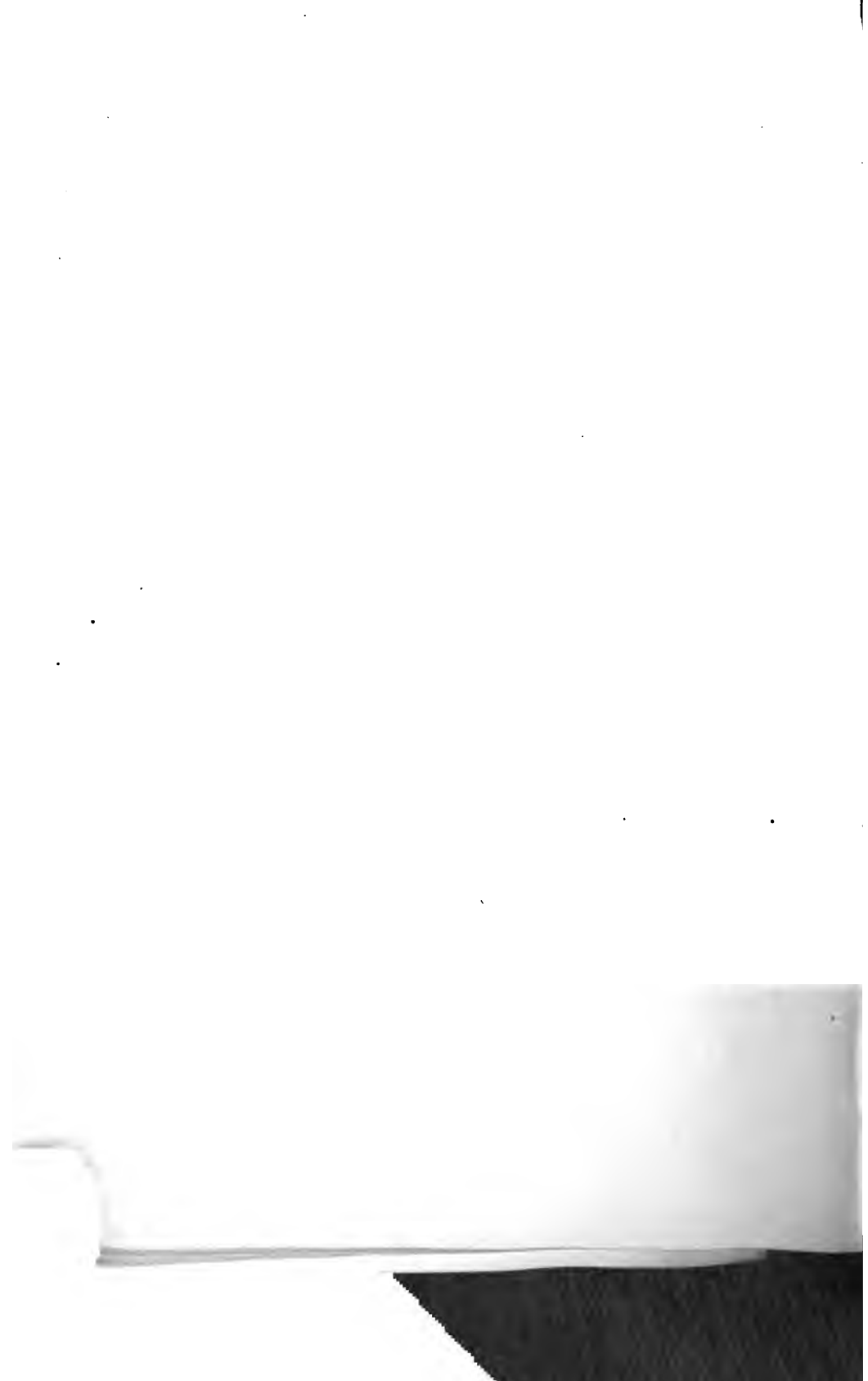
No. 62.—Landore Siemens steel 2-72. Naylor & Co. Sec. 70.

No. 63.—Landore Siemens steel 2-72. Naylor & Co. Sec. 70.

Tensile tests made from webs of rails, endurance tests made from heads.

CHEMICAL ANALYSES.

Rail number.	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
40	.26	.48	.17	.122	.053
41	.35	-----	.13	.068	.068
47	.53	.67	.12	.060	.082
49	.41	.73	.06	.069	.076
51	.41	.57	.02	.062	.089
52	.50	.49	.06	.118	.079
56	.45	1.57	.01	.061	.066
60	.39	.43	.04	.065	.081
62	.51	.41	.04	.060	.043
63	.44	.36	.05	.062	.044



RAIL JOINT.



TESTS OF THE FRICTIONAL RESISTANCE OF STEEL RAILS BETWEEN THEIR SPLICE BARS.

MATERIAL CONTRIBUTED BY MR. P. H. DUDLEY.

No. 10602.

Rail ends, 90-pound sections, with 6-hole splice bars, received from the Atlantic City Railroad.

Six $\frac{1}{2}$ " track bolts, 9 threads per inch, used. Diameter at root 6 threads, ".73. Bolts screwed up by railroad trackmen.

Square wire lock-nut device used under the bolt nuts.

Rail ends secured in the jaws of the testing machine and frictional resistance ascertained under tensile stresses applied axially to the rails.

Test with joint in original condition received from the trackmen.

Total applied loads.	Movement of rail ends at joint.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	
62,200	.01	
64,700	.02	
66,100	.03	
67,400	.04	
69,200	.06	
72,000	.08	
72,600	.10	
78,000	.12	
69,000	.14	
64,000	.16	
62,000	.20	Test discontinued.

Specimen removed from the testing machine, bolts released, and ends of rails again brought together and bolts retightened. A 28" track wrench was used in tightening the bolts, which were strained to nearly their maximum capacity. One bolt was fractured and replaced by a new one.

Total applied loads.	Movement of rail ends at joint.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	
53,000	.01	
62,000	.02	
62,000	.04	
62,100	.10	
60,200	.15	
65,800	.20	
68,000	.25	
74,000	.30	Test discontinued.

Joint remade, alternately tightening bolt with the 28" wrench and hammering the angle bars into place with a hand sledge.

Total applied loads.	Movement of rail ends at joint.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	
82,000	.01	
98,000	.08	
92,000	.06	Throbs; fluctuations in the resistance of the bars.
84,000	.06	
88,000	.10	
81,000	.15	
89,000	.20	
100,000	.22	
102,500	.28	
110,000	.26	Test discontinued.
118,000	.31	

Joint again remade, alternately tightening the bolts with the 28" track wrench and hammering the angle bars into place with a hand sledge, after which the bolts were released and taken out, leaving the angle bars alone, without bolts, holding the rail ends by the frictional resistance due to their wedge action between the head and base of the rail.

The adhesive resistance in this condition was found to be 45,600 pounds tension.

No. 7737.

Marks, 1.

Diameter ".798.

Sectional area, .50 square inch.

Gauged length, 8".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
500	1,000	0.	0.	
2,500	5,000	.0011	0.	Elastic limit. Load fell.
5,000	10,000	.0024	.....
10,000	20,000	.0053	.....
15,000	30,000	.0079	0.	
20,000	40,000	.0106	0.	
20,500	41,000	.0108	.....
21,000	42,000	.0111	.....
21,500	43,000	.0113	.....
22,000	44,000	.0115	.....
22,500	45,000	.0118	.....
23,000	46,000	.0121	.....
23,500	47,000	.0125	.....
20,500	41,000	.0167	.....
21,000	42,000	.0548	.....
21,500	43,000	.0950	.....
22,000	44,000	.19	.....
23,000	46,000	.21	.....
24,000	48,000	.24	.....
25,000	50,000	.29	.....
26,000	52,000	.34	.....
28,000	56,000	.46	.....
30,000	60,000	.65	.....
32,000	64,000	1.06	.....
82,680	65,360	1.70	.....
0	0	2.25	.....
				Tensile strength. =28.1 per cent.

Elongation of inch sections, ".19, ".20, ".27, ".63*, ".30, ".25, ".22, ".19.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 60.7 per cent.

Fractured 5".2 from the neck.

Appearance, fine silky, cup-shaped.

No. 7738.

Marks, 2.

Diameter, ".798.

Sectional area, .50 square inch.

Gauged length, 8".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
500	1,000	0.	0.	
2,500	5,000	.0010	0.	
5,000	10,000	.0024	.....
10,000	20,000	.0061	.....
15,000	30,000	.0078	0.	
20,000	40,000	.0105	0.	
20,500	41,000	.0108	.....
21,000	42,000	.0110	.....
21,500	43,000	.0112	.....
22,000	44,000	.0115	.....
22,500	45,000	.0117	.....
23,000	46,000	.0120	.....
23,500	47,000	.0122	.....
24,000	48,000	.0125	.....
24,500	49,000	.0128	.....
25,000	50,000	.0131	0.	
25,500	51,000	.....	.....	Elastic limit. Load fell.
20,500	41,000	.0250	.....
21,000	42,000	.0943	.....
22,000	44,000	.18	.....
23,000	46,000	.21	.....
24,000	48,000	.25	.....
25,000	50,000	.29	.....
26,000	52,000	.34	.....
28,000	56,000	.46	.....
30,000	60,000	.60	.....
32,000	64,000	1.15	.....
32,340	64,680	1.64	.....	Tensile strength.
0	0	2.25	.....	=28.1 per cent.

Elongation of inch sections, ".19, ".21, ".23, ".27, ".63", ".29, ".22, ".21.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 60.7 per cent.

Fractured 4".95 from the neck.

Appearance, fine silky, cup-shaped.

No. 7739.

Marks, 3.
 Diameter, ".798.
 Sectional area, .50 square inch.
 Gauged length, 8".

Applied loads.		In gauged length.		Remarks.	
Total.	Per square inch.	Elongation.	Set.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>		
500	1,000	0.	0.	Initial load.	
2,500	5,000	.0011	0.		
5,000	10,000	.0025	0.		
10,000	20,000	.0053	0.		
15,000	30,000	.0080	0.		
20,000	40,000	.0106	0.		
20,500	41,000	.0108	.....	
21,000	42,000	.0110	.....	
21,500	43,000	.0113	.....	
22,000	44,000	.0116	.....	
22,500	45,000	.0119	.....	
23,000	46,000	.0121	.....	
23,500	47,000	.0124	.....	
23,820	47,640		Elastic limit. Load fell.
20,500	41,000	.0207	.....	
21,000	42,000	.0760	.....	
22,000	44,000	.17	.....	
23,000	46,000	.20	.....	
24,000	48,000	.24	.....	
25,000	50,000	.28	.....	
26,000	52,000	.33	.....	
28,000	56,000	.45	.....	
30,000	60,000	.63	.....	
32,000	64,000	1.00	.....	
32,600	65,200	1.62	Tensile strength.	
0	0	2.28	=28.5 per cent.	

Load on bar at time of rupture, 24,600 pounds=125,250 pounds per square inch on area at fracture.

Elongation of inch sections, ".20, ".25, ".58*, ".35, ".26, ".24, ".21, ".19.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 60.7 per cent.

Fractured 4".15 from the neck.

Appearance, fine silky, cup-shaped.

Marks, 4.
 Diameter, ".798.
 Sectional area, .50 square inch.
 Gauged length, 8".

Applied loads.		In gauged length.		Remarks.	
Total.	Per square inch.	Elongation.	Set.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.	
600	1,000	0.	0.		
2,500	5,000	.0011	0.		
5,000	10,000	.0025	.....	
10,000	20,000	.0052	.....	
15,000	30,000	.0079	0.		
20,000	40,000	.0104	0.		
20,500	41,000	.0107	.....	
21,000	42,000	.0110	.....	
21,500	43,000	.0113	.....	
22,000	44,000	.0115	.....	
22,500	45,000	.0118	.....	
23,000	46,000	.0121	.....	
23,500	47,000	.0123	.....	
24,000	48,000	.0126	.....	
24,500	49,000	.0129	.....	
21,000	42,000	.0219	.....	
21,500	43,000	.0690	.....	
22,000	44,000	.1440	.....	
22,000	44,000	.17	.....	
24,000	48,000	.20	.....	
24,000	48,000	.23	.....	
25,000	50,000	.28	.....	
26,000	52,000	.32	.....	
28,000	56,000	.45	.....	
30,000	60,000	.63	.....	
32,000	64,000	1.02	.....	
32,370	64,740	1.61	.....	
0	0	2.26	.....	
					Elastic limit. Load fell.
					Tensile strength. = 28.3 per cent.

Load on bar at time of rupture, 24,200 pounds=123,220 pounds per square inch on area at fracture.

Elongation of inch sections, ".19, ".24, ".27, ".57*, ".36, ".23, ".21, ".19.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 60.7 per cent.

Fractured 5".34 from the neck.

Appearance, fine silky, cup-shaped.

No. 7741.

Marks, 5.

Diameter, ".798.

Sectional area, .50 square inch.

Gauged length, 8".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
2,500	1,000	0.	0.	Initial load.
5,000	5,000	.0011	0.	
10,000	10,000	.0025	.....
15,000	20,000	.0053	.....
20,000	30,000	.0079	0.	
20,500	40,000	.0105	0.	
21,000	41,000	.0107	.....
21,500	42,000	.0110	.....
21,500	43,000	.0112	.....
22,000	44,000	.0115	.....
22,500	45,000	.0117	.....
23,000	46,000	.0120	.....
23,500	47,000	.0123	.....
24,000	48,000	.0126	.....
24,500	49,000	.0129	.....
24,680	49,360	Elastic limit. Load fell.
21,000	42,000	.0183	Tensile strength. = 28 per cent.
21,500	43,000	.0284	.....
22,000	44,000	.0698	.....
22,000	44,000	.1675	.....
23,000	46,000	.20	.....
24,000	48,000	.23	.....
25,000	50,000	.27	.....
26,000	52,000	.31	.....
28,000	56,000	.43	.....
30,000	60,000	.63	.....
32,000	64,000	1.05	.....
32,500	65,000	1.56	.....
0	0	2.24	.....

Load on bar at time of rupture, 24,050 pounds=122,450 pounds per square inch on area at fracture.

Elongation of inch sections, ".21, ".25, ".35, ".57*, '.25 ".21, ".21, ".19.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 60.7 per cent.

Fractured 4".5 from the neck.

Appearance, fine silky, cup-shaped.

No. 7742.

Marks, 6.

Diameter, ".798.

Sectional area, .50 square inch.

Gauged length, 8".

Applied loads.		In gauged length.		Remarks.	
Total.	Per square inch.	Elongation.	Set.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>		
500	1,000	0.	0.	Initial load.	
2,500	5,000	.0012	0.		
5,000	10,000	.0025	-----		
10,000	20,000	.0052	-----		
15,000	30,000	.0079	0.		
20,000	40,000	.0104	0.		
20,500	41,000	.0106	-----		
21,000	42,000	.0109	-----		
21,500	43,000	.0112	-----		
22,000	44,000	.0115	-----		
22,500	45,000	.0117	-----		
23,000	46,000	.0120	-----		
23,500	47,000	.0123	-----		
24,000	48,000	.0125	-----		
24,500	49,000	.0127	-----		
25,000	50,000	.0131	0.		
25,100	50,200	-----	-----		Elastic limit. Load fell.
20,500	41,000	.0251	-----		
21,000	42,000	.0289	-----		
21,500	43,000	.0312	-----		
22,000	44,000	.0397	-----		
23,000	46,000	.17	-----		
23,000	46,000	.19	-----		
24,000	48,000	.22	-----		
25,000	50,000	.26	-----		
26,000	52,000	.31	-----		
28,000	56,000	.42	-----		
30,000	60,000	.61	-----		
32,000	64,000	.99	-----		
32,540	65,080	1.38	-----	Tensile strength. = 23 per cent.	
0	0	2.24	-----		

Load on bar at time of rupture, 24,000 pounds=122,200 pounds per square inch on area at fracture.

Elongation of inch sections, ".20, ".23, ".26, ".64*, ".31, ".21, ".21, ".18.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 60.7 per cent.

Fractured 5".25 from the neck.

Appearance, fine silky, cup-shaped.

No. 7743.

Marks, 7.
 Diameter, ".798.
 Sectional area, .50 square inch.
 Gauged length, 8".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
500	1,000	0.	0.	Initial load.
2,500	5,000	.0012	0.	
5,000	10,000	.0025	.....
10,000	20,000	.0063	.....
15,000	30,000	.0079	0.	
20,000	40,000	.0106	0.	
20,500	41,000	.0108	.....
21,000	42,000	.0111	.....
21,500	43,000	.0114	.....
22,000	44,000	.0116	.....
22,500	45,000	.0118	.....
23,000	46,000	.0121	.....
23,500	47,000	.0124	.....
23,800	47,600	.....	.....		Elastic limit. Load fell.
21,000	42,000	.0166	.....
21,500	43,000	.0198	.....
21,500	43,000	.1062	.....
22,000	44,000	.16	.....
23,000	46,000	.20	.....
24,000	48,000	.22	.....
25,000	50,000	.27	.....
26,000	52,000	.31	.....
28,000	56,000	.43	.....
30,000	60,000	.63	.....
32,000	64,000	1.06	.....
32,280	64,560	1.53	Tensile strength. =23.5 per cent.
0	0	2.28	.....

Load on bar at time of rupture, 24,200 pounds = 123,220 pounds per square inch on area at fracture.

Elongation of inch sections, ".19, ".20, ".24, ".28, ".42, ".52*, ".23, ".20.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 60.7 per cent.

Fractured 4".29 from the neck.

Appearance, fine silky, cup-shaped.

No. 7744.

Marks, 8.

Diameter, ".798.

Sectional area, .50 square inch.

Gauged length, 8".

Applied loads.		In gauged length.		Remarks.	
Total.	Per square inch.	Elongation.	Set.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>		
500	1,000	0.	0.	Initial load.	
2,500	5,000	.0011	0.		
5,000	10,000	.0024	.....	
10,000	20,000	.0062	.....	
15,000	30,000	.0078	0.		
20,000	40,000	.0106	0.		
20,500	41,000	.0107	.....	
21,000	42,000	.0110	.....	
21,500	43,000	.0113	.....	
22,000	44,000	.0115	.....	
22,500	45,000	.0117	.....	
23,000	46,000	.0120	.....	
23,500	47,000	.0123	.....	
24,000	48,000	.0126	.....	
24,500	49,000	.0128	.....	
25,000	50,000	.0130	0.		
25,500	51,000	.0133	.....	
25,700	51,400		Elastic limit. Load fell.
20,500	41,000	.0190	.....	
21,000	42,000	.0263	.....	
21,500	43,000	.0675	.....	
22,000	44,000	.1543	.....	
22,000	44,000	.16	.....	
23,000	46,000	.18	.....	
24,000	48,000	.21	.....	
25,000	50,000	.26	.....	
26,000	52,000	.31	.....	
28,000	56,000	.43	.....	
30,000	60,000	.63	.....	
32,000	64,000	1.06	Tensile strength. =29.4 per cent.	
32,390	64,780	1.57	.....	
0	0	2.35	.....	

Load on bar at time of rupture, 24,300 pounds=123,730 pounds per square inch on area at fracture.

Elongation of inch sections, ".23, ".31, ".29, ".65*, ".26, ".22, ".21, ".18.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 60.7 per cent.

Fractured 5" from the neck.

Appearance of fracture, fine silky, cup-shaped.

No. 7745.

Marks, 9.
 Diameter, ".798.
 Sectional area, .50 square inch.
 Gauged length, 8".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Elongation.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
500	1,000	0.	0.	
2,500	5,000	.0011	0.	
5,000	10,000	.0025	.....
10,000	20,000	.0053	.....
15,000	30,000	.0079	0.	
20,000	40,000	.0108	0.	
20,500	41,000	.0109	.....
21,000	42,000	.0111	.....
21,500	43,000	.0114	.....
22,000	44,000	.0117	.....
22,500	45,000	.0119	.....
23,000	46,000	.0122	.....
23,500	47,000	.0124	.....
24,000	48,000	.0127	.....
24,470	48,940	.....	.....
21,000	42,000	.0239	.....
		.0464	.....
21,500	43,000	.1525	.....
22,000	44,000	.16	.....
23,000	46,000	.18	.....
24,000	48,000	.21	.....
25,000	50,000	.25	.....
26,000	52,000	.30	.....
28,000	56,000	.42	.....
30,000	60,000	.61	.....
32,000	64,000	1.02	.....
32,420	64,840	1.53	.....
0	0	2.22	.....
				Elastic limit. Load fell.
				Tensile strength. = 27.8 per cent.

Load on bar at time of rupture, 24,100 pounds=122,710 pounds per square inch on area at fracture.

Elongation of inch sections ".19, ".18, ".22, ".34, ".60*, ".27, ".22, ".20.

Diameter at fracture, ".50; area, .1964 square inch.

Contractions of area, 60.7 per cent.

Fractured at the middle of the stem.

Appearance, fine silky, cup-shaped.

No. 7746.

Marks, 10.
 Diameter, ".798.
 Sectional area, .50 square inch.
 Gauged length, 8".

Applied loads.		In gauged length.		Remarks.	
Total.	Per square inch.	Elongation.	Set.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>		
500	1,000	0.	0.	Initial load.	
2,500	5,000	.0011	0.		
5,000	10,000	.0024	.....	
10,000	20,000	.0053	.....	
15,000	30,000	.0080	0.		
20,000	40,000	.0105	0.		
20,500	41,000	.0108	.....	
21,000	42,000	.0111	.....	
21,500	43,000	.0113	.....	
22,000	44,000	.0115	.....	
22,500	45,000	.0118	.....	
23,000	46,000	.0121	.....	
23,500	47,000	.0123	.....	
23,780	47,560		Elastic limit. Load fell.
20,500	41,000	.0179		Immediate elongation.
21,000	42,000	.1462		Elongation after sustaining load 20 minutes.
21,500	43,000	.1580	.....	
22,000	44,000	.1650	.....	
23,000	46,000	.20	.....	
24,000	48,000	.24	.....	
25,000	50,000	.28	.....	
26,000	52,000	.33	.....	
28,000	56,000	.45	.....	
30,000	60,000	.65	.....	
32,000	64,000	1.19	.....	
32,180	64,280	1.58	Tensile strength.	
0	0	2.21	=27.6 per cent.	

Load on bar at the time of rupture, 24,050 pounds = 122,450 pounds per square inch on area at fracture.

Elongation of inch sections, ".19, ".21, ".25, ".54*, ".39, ".24, ".21, ".18.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 60.7 per cent.

Fractured at the middle of the stem.

Appearance, fine silky, cup-shaped.

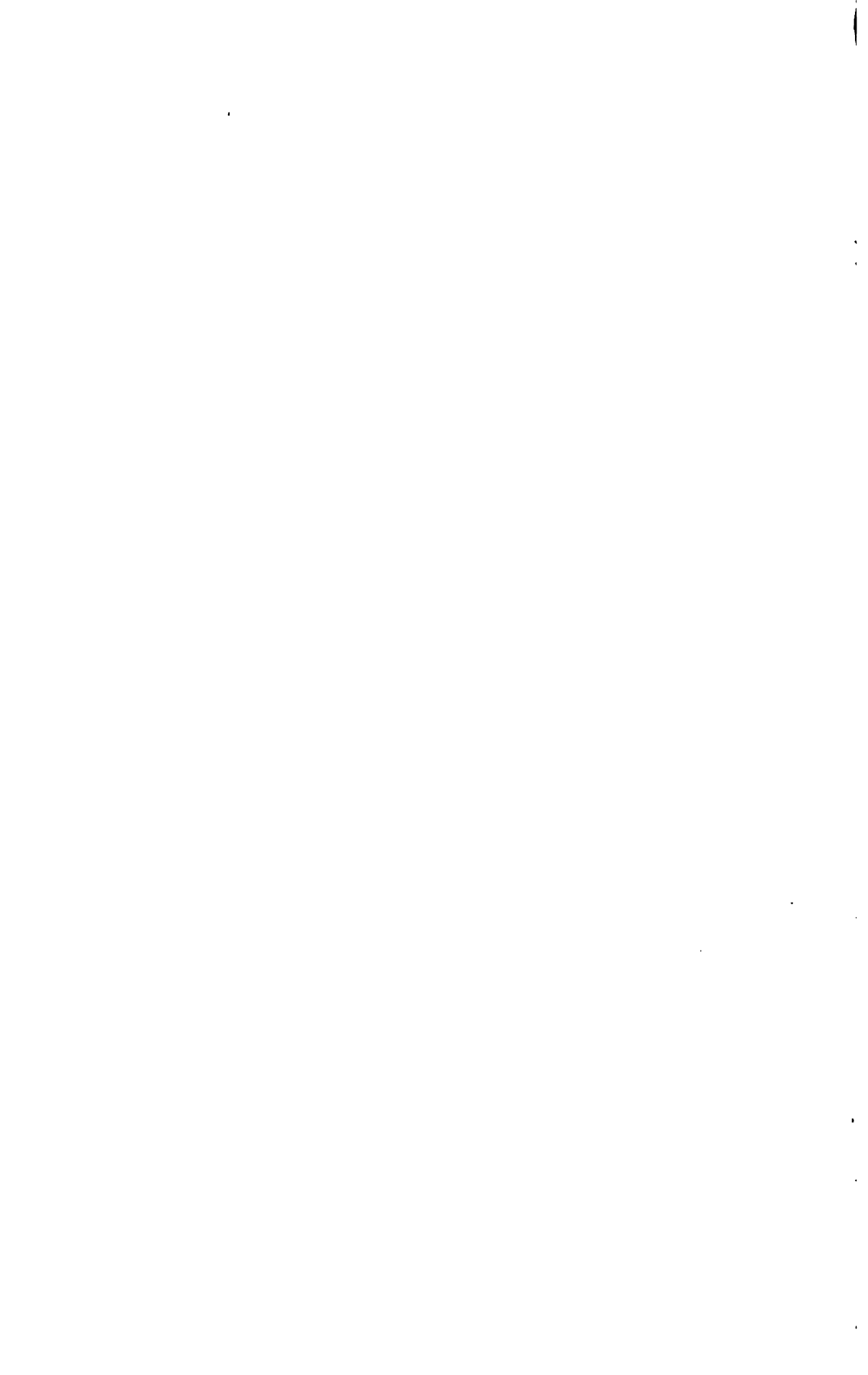
TABLATION OF TENSION TESTS OF STEEL BARS FOR COMPARISON OF TESTING MACHINES IN GERMANY.

STEMS OF SPECIMENS, .798 DIAM., 8" LONG.

No. of test.	Mark on specimen.	Diameter.	Sectional area.	Elastic limit.		Tensile strength.		Elongation in 8 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
				Total.	Per square inch.	Total.	Per square inch.	Inches.	Per ct.					Inch.	Per ct.
7737	1	.798	23,500	29,000	36,860	46,225	28.1	1.25	60.7	19	20	27	53*
7738	2	.798	23,500	31,000	37,840	46,950	28.1	1.25	60.7	19	21	28	57
7739	3	.798	23,500	47,000	37,800	46,230	28.3	1.25	60.7	20	25	32	58*
7740	4	.798	24,680	46,800	37,570	46,740	28.3	1.25	60.7	19	24	27	57*
7741	5	.798	23,100	49,200	37,540	46,000	28.0	1.25	60.7	21	23	28	58*
7742	6	.798	23,800	47,600	37,580	46,540	28.5	1.25	60.7	20	23	26	58*
7743	7	.798	23,700	51,400	37,580	46,780	27.8	1.25	60.7	18	21	24	58*
7744	8	.798	24,470	49,940	37,450	46,540	27.6	1.25	60.7	18	18	22	57*
7746	10	.798	23,780	47,580	37,180	46,260	27.6	2.21	60.7	19	21	25	54*



**TURNED WOODEN STICKS AND STEEL TUBING.
TRANSVERSE TESTS.**



TRANSVERSE TESTS OF TURNED WOODEN STICKS AND STEEL TUBING

End supports, 38" apart.

Middle plunger, 1½" length of bearing.

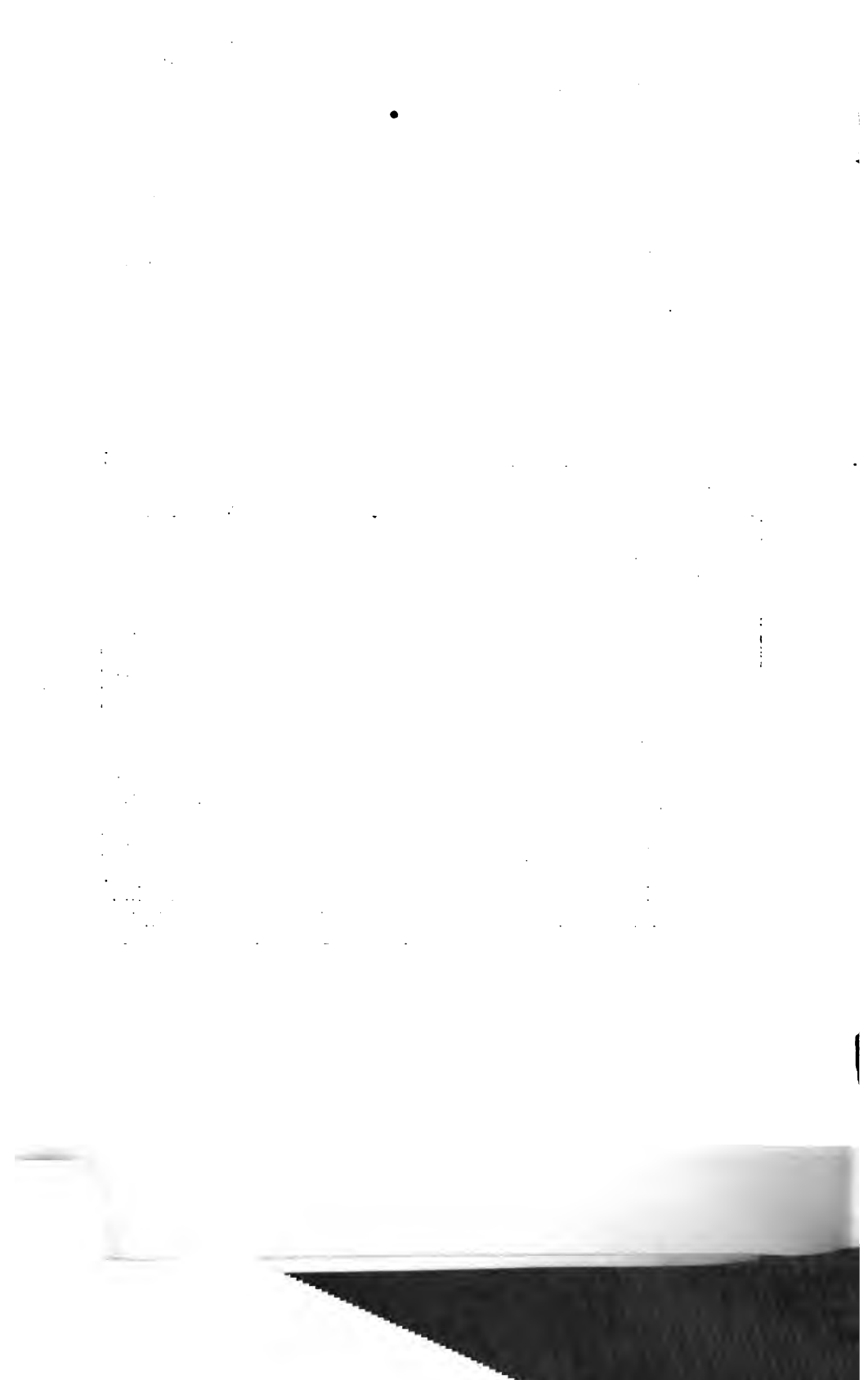
Curved seats, leather lined, at middle plunger and end supports.

Kind of material.	Dimensions.		Weight.	Transverse strength.	
	Length.	Diameter.		Total.	Modulus of rupture per square inch.
	<i>Inches.</i>	<i>Inches.</i>	<i>Lbs. ozs.</i>	<i>Pounds.</i>	<i>Pounds.</i>
White pine	40.07	2.34	2 3½	1,224	9,240
Oregon pine (1)	40.08	2.34	2 12½	1,556	11,750
Yellow pine	40.06	2.34	4 9½	2,990	22,580
Hickory	40.08	2.34	5 ½	2,600	19,640
Steel tube	40.04	2.35 2.22	5 2½	2,020	74,000
Oregon pine (2)	40.05	3.00	4 11½	3,720	13,330
Oregon pine (3)	40.07	3.05	5 2½	3,180	10,850

Sample of Oregon pine (1) began to crack under 1,400 pounds load.
Wooden samples fractured with splintering breaks on the tension side at the middle of their lengths.

The steel tube buckled on the compression side at the middle of its length.

Applied loads.	Deflections.						
	White pine.	Oregon pine (1).	Yellow pine.	Hickory.	Steel tube.	Oregon pine (2).	Oregon pine (3).
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>
200	0.	0.	0.	0.	0.	0.	0.
400	.13	.12	.07	.07	.02	.08	.02
600	.27	.23	.12	.15	.06	.09	.09
800	.41	.37	.19	.22	.11	.12	.13
1,000	.56	.48	.26	.30	.14	.16	.19
200	.08	.04	.01	.02	.01	0.	0.
1,200	.84	.67	.32	.39	.19	.21	.23
1,400	.....	.....	.39	.48	.23	.26	.29
1,600	.....	.....	.44	.58	.31	.31	.32
1,800	.....	.....	.52	.67	.43	.35	.38
2,000	.....	.....	.60	.78	.92	.39	.42
200	.....	.....	.08	.10	.60	0.	.01
2,200	.....	.....	.65	.92	.....	.42	.47
2,400	.....	.....	.73	1.08	.....	.48	.52
2,600	.....	.....	.83	.....	.....	.52	.59
2,800	.....	.....	.92	.....	.....	.59	.64
3,000	.....	.....	.....	.....	.....	.65	.73
200	.....	.....	.....	.....	.....	.03	.06
3,200	.....	.....	.....	.....	.....	.72	.....
3,400	.....	.....	.....	.....	.....	.82	.....
200	.....	.....	.....	.....	.....	.11	.....
3,600	.....	.....	.....	.....	.....	1.01	.....



**TESTS OF MCKIM GASKETS UNDER HYDROSTATIC
PRESSURES.**

11/11/11

**GENERAL REMARKS AND CONCLUSIONS ON THE EFFICIENCY
OF THE M'KIM GASKETS.**

1. In its construction the gasket provides the means of seating against surfaces of considerable irregularity.

2. The sheet-copper envelope, while retaining the softer material inclosed therein from lateral flow beyond the ordinary limits of the gasket, permits the latter to flow and accommodate itself to the surfaces of the joint.

3. The joint possesses durability and may be made and broken without apparent injury.

4. The efficiency of the joint depends upon the initial compression of the gasket by the gland.

5. Under the conditions of the present test excessive hammering of the wrench on the gland was required to make a tight joint for pressures above 600 to 800 pounds per square inch.

6. The difficulty of making tight joints against high pressures appears to limit the usefulness of the packings to the pressures last mentioned. This conclusion has reference to present dimensions of glands and to the number of square inches of surface over which the joints are made.

Three McKim gaskets were made up in the arsenal machine shop, being seated in recesses in a 12-inch mortar carriage recoil cylinder, the dimensions of which, and the glands used therewith, were as follows:

Gaskets.			Glands.	
Number of—	Exterior diameter.	Interior diameter.	Diameter.	Threads per inch.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	
1	9.25	8.	8.	6
2	2.80	2.08	2.08	6
1	1.85	1.25	1.25	7

The gaskets were seated under the heads of the glands, and seating pressures received over the full surface of each gasket. The glands were screwed down by means of forked wrenches or spanner, and tightened by sledging the wrench in conjunction with a pull being exerted on the handle of the wrench.

There was a rapid application of 3,200 pounds per square inch to the packings, which caused them to leak. Repeated applications resulted in the same manner.

Releasing the pressures, the glands were tightened as before and testing resumed under lower pressures.

At 800 pounds pressure the joints were tight;

At 1,000 pounds pressure slight leakage at 8" by 9".25 gasket;

At 1,200 pounds pressure large and one medium sized gaskets leaked.

Pressures released and glands again tightened.

At 800 pounds pressure the joints were tight;

At 1,000 pounds pressure leaked an occasional drop at 8" by 9".25 gasket;

At 1,200 pounds pressure leaked an occasional drop at 8" by 9".25 gasket;

At 2,000 pounds pressure dropped faster;

At 2,200 pounds pressure large and one medium sized gaskets leaked.

Joints now broken by backing off the glands, and remade as before.
 At 600 pounds pressure the joints were tight;
 At 800 pounds pressure one medium-sized gasket leaked slightly, but was stopped by tightening the gland;
 At 1,000 pounds pressure the joints were tight;
 At 1,200 pounds pressure large gasket leaked slightly; again tightened the gland;
 At 1,400 pounds pressure the joints were tight;
 At 1,600 pounds pressure the joints were tight;
 At 1,800 pounds pressure the joints were tight;
 At 2,000 pounds pressure the joints were tight;
 At 2,200 pounds pressure the joints were tight;
 At 2,400 pounds pressure leaked an occasional drop at the medium-sized gasket;
 At 3,000 pounds pressure large and medium sized gaskets leaked; again tightened the glands;
 At 3,200 pounds pressure an occasional drop leaked past the large and medium sized gaskets.

Test discontinued.

The smallest and one of the medium sized gaskets remained tight throughout. The gaskets were in good condition at the end of the test.

The construction of the McKim gasket and the general behavior of those tested lead to the conclusions prefixed.

There were six so-called "fiber" gaskets used about the recoil cylinder during the above tests. Their dimensions were as follows:

Fiber gaskets.			Glands.	
Number of—	Exterior diameter.	Interior diameter.	Diameter.	Threads per inch.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	
1	2.49	1.99	1.99	6
5	1.74	1.24	1.24	7

These joints remained tight throughout the test.

The annular widths of the fiber gaskets were less than the widths of the McKim gaskets, as here shown:

Name of gasket.	Exterior diameter.	Annular width.
	<i>Inches.</i>	<i>Inch.</i>
McKim.....	9.25	.625
Do.....	2.80	.36
Do.....	1.85	.30
Fiber.....	2.49	.25
Do.....	1.74	.25

The difficulty in making tight joints was greater with the wider gaskets.

The recoil cylinder was assembled with its piston in place. Garlock braided packing was used about the piston rod at the cylinder heads. Diameter of piston rod, 3".50. Its gland measured 4".77 exterior diameter, and had 6 threads per inch. Leakage occurred about the packing, necessitating frequent tightening of the gland by means of spanner, which was sledged.

BEARING METALS.



TEST OF "NOHEET" BEARING METAL.

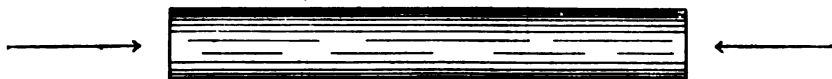
Two kinds of metal were submitted, a dark colored and a lighter colored metal. The following tests were made:

- Compression tests.
- Indentation, or hardness, tests.
- Frictional tests with a weighted steel shaft in a box lined with the bearing metal.
- Specific gravity determinations.
- Chemical analyses.

COMPRESSION TESTS.

SPECIMENS FROM BARS CAST IN WOODEN MOLDS AT WATERTOWN ARSENAL AND TURNED TO FINISHED DIMENSIONS.

DARK-COLORED METAL.



Length, 8". Diameter, 1".128.
 Sectional area, 1 square inch.
 Gauged length, 4".

Applied loads per square inch.	Compression.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
500	0.	0.	Initial load
1,000	.0008		Compression after 5 minutes.
1,000	.0010	.0003	
1,500	.0019		Do.
1,500	.0020	.0005	Do.
2,000	.0029		Do.
2,000	.0030	.0006	Do.
2,500	.0039		Do.
2,500	.0041	.0008	Do.
3,000	.0050		Do.
3,000	.0052	.0011	Do.
3,500	.0063		Do.
3,500	.0065	.0015	Do.
4,000	.0076		Do.
4,000	.0079	.0020	Do.
4,500	.0091		Do.
4,500	.0095	.0025	Do.
5,000	.0106		Do.
5,000	.0113	.0034	Do.
5,500	.0126		Do.
5,500	.0136	.0051	Do.
6,000	.0154		Do.
6,000	.0178	.0089	Do.
6,500	.0239		Ultimate strength.
8,200			

Failed by triple flexure.

LIGHT-COLORED METAL.

Length, 8". Diameter, 1".129.
 Sectional area, 1 square inch.
 Gauged length, 4".

Applied loads per square inch.	Compression.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
500	0.	0.	Initial load.
1,000	.0007		
1,000	.0017	.0011	Compression after 5 minutes.
1,500	.0024		
1,500	.0031	.0020	Do.
2,000	.0040		
2,000	.0047	.0030	Do.
2,500	.0055		
2,500	.0068	.0044	Do.
3,000	.0074		
3,000	.0090	.0057	Do.
3,500	.0100		
4,000	.0116		
4,500	.0139		
5,000	.0165		
5,500	.0204		
6,000	.0260		
6,500	.0349		
8,500			Ultimate strength.

Failed by triple flexure.

Relative hardness determined by means of cut made with pyramidal indenting tool.

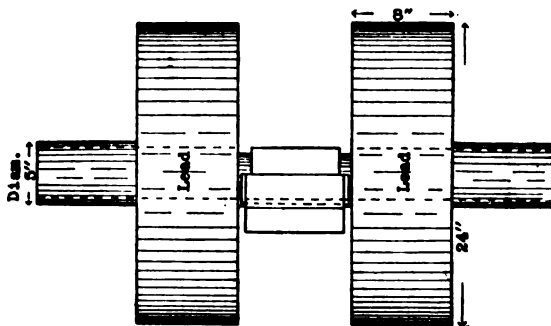
Owing to the lower resistance of bearing metals, in comparison with the hardness of steel, indenting loads of 1,000 pounds were used instead of 10,000 pounds employed for steel.

In the present case, one sample each of the dark and the light-colored "Noheet" metal were indented, and a sample of bearing metal branded "Torrey Antifriction Metal."

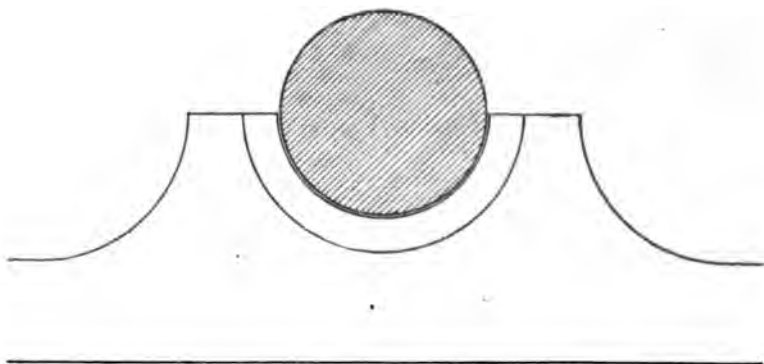
Kind of metal.	Indenting pressure.	Length of cut.
	<i>Pounds.</i>	<i>Inch.</i>
"Noheet," dark colored	1,000	.628
"Noheet," light colored	1,000	.577
"Torrey Antifriction Metal"	1,000	.548

A cast-iron box was lined with "Noheet" dark-colored metal, cast in place and bored to obtain a smooth bearing surface.

SKETCH OF TESTING FIXTURE.



Weight of lead and hubs, 2,870 pounds.



CAST-IRON BOX.

Finished dimensions of bearing: Diameter, 5"; length, $4\frac{1}{2}$ ".

The behavior of a weighted shaft was determined, imparting rotary motion to the same by means of a cord and falling weight. Two lead wheels were used, the aggregate weight of which, with their hubs and drums, was 2,870 pounds. The falling weight, a cast-iron spherical shot, weighed 175 pounds. The diameter of the cord, a braided linen line, was $\frac{7}{16}$ ". The lubricant was sperm oil.

A number of preliminary experiments were made, in which the cord was wrapped around one of the lead wheels, 24" diameter. After this the cord was wrapped around one of the 5" drums. In each case the weight dropped 16 feet $1\frac{1}{4}$ inches.

When the cord was used over the 24" wheel, the 175-pound weight promptly imparted a rotary motion to the loaded shaft. When the cord was wrapped around the 5" drum the 175-pound weight was insufficient to overcome the frictional resistance, and it was necessary to start rotation of the shaft by the hand.

pound weight, and thereafter until rotation ceased:

Number of experiment.	Total number of rotations.	Remarks.	
1	5½	175-pound falling weight acting on cord wrapped around 24" diameter of lead wheel.	
2	8		
3	10		
4	9		
5	10		
6	11½		
7	11		
8	10½		
9	12		175-pound falling weight acting on cord wrapped around 5" drum.
10	13½		
11	16½		
12	11½		
13	14½		
14	16½		
Direction of rotation of shaft reversed.			
15	16		
16	18		
17	20½		
18	18		
19	18½		
20	18½	Test discontinued.	

CHEMICAL ANALYSES.

Kind of metal.	Copper.	Tin.	Lead.	Iron.	Anti- mony.	Magne- sium.
"Nohest," dark colored .....		.25	98.25	.04		.96
"Nohest," light colored .....	.45	7.35	67.00		25.20	
"Torrey Antifriction Metal"			81.06		19.00	

SPECIFIC GRAVITY DETERMINATIONS.

Kind of metal.	Specific gravity.
"Nohest," dark colored	10.739
"Nohest," light colored	9.710
"Torrey Antifriction Metal"	10.066

CORDAGE.



LINEN SHOT LINES FOR THE UNITED STATES LIFE-SAVING SERVICE.

No. 9 SHOT LINES.

Diameter, " .29.

Three strands of 16 threads each.

Lay one turn in 1".4.

Tested in 4-foot lengths.

No. of test.	Weight of coll.	End of coil tested.	Tensile strength.	Parted.
	<i>Lbs. ozs.</i>		<i>Pounds.</i>	
1	35 4	Outside...	1,118	1 strand at the pin.
2	35 8	....do....	1,210	Do.
3	35 4	Inside....	1,216	Do.
4	35 8	Outside....	1,120	Do.
5	35 8	....do....	1,200	Do.
6	35 4	Inside....	1,200	1 strand 14" from the pin.
7	35 8	Outside....	1,184	1 strand at the pin.
8	35 8	....do....	1,224	Do.
9	35 2	....do....	1,334	Do.
10	35 8	....do....	1,266	Do.
11	35 2	....do....	1,256	Do.
12	35 0	....do....	1,151	Do.
13	35 8	....do....	1,176	1 strand 18" from the pin.
14	35 4	....do....	1,302	1 strand at the pin.
15	35 8	....do....	1,080	2 strands at the pin.
15a	35 8	....do....	1,270	1 strand at the pin.
16	35 12	....do....	1,298	Do.
17	35 4	Inside....	1,070	1 strand 2' from the pin.
17a	35 4	Outside....	1,380	1 strand at the pin.
18	35 2	....do....	1,080	Do.
19	35 4	....do....	1,200	Do.
20	35 12	Inside....	1,142	1 strand 15" from the pin.
21	35 4	Outside....	1,205	1 strand 10" from the pin.
22	35 4	....do....	1,240	1 strand at the pin.
23	35 8	....do....	1,185	1 strand 18" from the pin.
24	35 4	....do....	1,260	1 strand at the pin.
25	35 4	....do....	1,295	2 strands at the pin.
26	36 4	....do....	1,271	1 strand at the pin.
27	35 0	....do....	1,238	1 strand 18" from the pin.
28	35 4	....do....	1,124	1 strand at the pin.
29	35 4	....do....	1,266	Do.
30	35 4	....do....	1,282	Do.
31	35 8	....do....	1,146	1 strand 12" from the pin.
32	35 4	....do....	1,184	1 strand at the pin.
33	35 2	....do....	1,156	Do.
34	35 4	....do....	1,272	Do.
35	36 4	Inside....	1,155	Do.
36	35 8	Outside....	980	Do.
36a	35 8	....do....	1,298	Do.
37	35 8	Inside....	1,230	Do.
38	35 4	Outside....	1,200	Do.
39	35 4	Inside....	1,198	Do.
40	35 8	Outside....	1,250	Do.
41	36 1	....do....	1,090	Do.
42	35 2	....do....	1,205	Do.
43	35 4	....do....	1,165	Do.
44	35 8	....do....	1,300	Do.
45	35 4	....do....	1,225	Do.
46	35 4	....do....	1,292	Do.
47	35 4	....do....	1,280	Do.
48	35 4	....do....	1,150	Do.
49	35 2	....do....	1,270	Do.
50	35 8	....do....	1,080	Do.

No. 7 SHOT LINES.

Diameter, ".22.

Three strands of 9 threads each.

Lay one turn in 1".

Tested in 4-foot lengths.

No. of test.	Weight of coil.	End of coil tested.	Tensile strength.	Parted.
	<i>Lbs. ozs.</i>		<i>Pounds.</i>	
51	21 7	Outside...	674	1 strand at the pin.
52	21 7½	.....do.....	794	Do.
53	21 8½	Inside.....	732	Do.
54	21 8	Outside.....	753	Do.
55	21 8½	.....do.....	827	2 strands at the pin.
56	21 9	.....do.....	804	1 strand 18" from the pin.
57	21 11	.....do.....	842	3 strands 8" from the pin.
58	21 8½	.....do.....	800	1 strand at the pin.
59	21 9	.....do.....	800	1 strand 4" from the pin.
60	21 10	.....do.....	776	1 strand at the pin.
61	21 8	.....do.....	794	Do.
62	21 8½	.....do.....	742	Do.
63	21 8½	.....do.....	846	Do.
64	21 9	.....do.....	783	Do.
65	21 8	.....do.....	786	Do.
66	21 7½	.....do.....	774	1 strand 6" from the pin.
67	21 10½	.....do.....	774	1 strand at the pin.
68	21 7½	.....do.....	806	Do.
69	21 8½	Inside.....	776	Do.
70	21 7½	.....do.....	695	Do.
71	21 8½	Outside.....	765	3 strands at the pin.
72	21 8	.....do.....	780	1 strand 24" from the pin.
73	21 9	.....do.....	796	1 strand at the pin.
74	21 8½	.....do.....	800	2 strands at the pin.
75	21 10	.....do.....	763	1 strand at the pin.
76	21 9	.....do.....	802	Do.
77	21 10½	.....do.....	848	Do.
78	21 9	.....do.....	796	2 strands at the pin.
79	21 10½	.....do.....	798	1 strand at the pin.
80	21 8½	.....do.....	810	Do.
81	21 8½	.....do.....	840	Do.
82	21 8½	.....do.....	762	Do.
83	21 9½	Inside.....	737	2 strands at the pin.
84	21 9	Outside.....	779	1 strand at the pin.
85	21 8½	Inside.....	726	Do.
86	21 10	Outside.....	864	1 strand 12" from the pin.
87	21 8	Inside.....	759	2 strands at the pin.
88	21 8	Outside.....	799	1 strand at the pin.
89	21 10	.....do.....	794	Do.
90	21 7	.....do.....	881	3 strands at the pin.
91	21 8	.....do.....	870	1 strand at the pin.
92	21 8½	.....do.....	700	Do.
93	21 9	.....do.....	716	1 strand 4" from the pin.
94	21 8	.....do.....	776	2 strands at the pin.
95	21 8	.....do.....	600	1 strand at the pin.
95a	21 8	.....do.....	760	Do.
96	21 8	.....do.....	797	Do.
97	21 9	Inside.....	785	2 strands at the pin.
98	21 10½	Outside.....	850	1 strand 16" from the pin.
99	21 11	.....do.....	863	1 strand 8" from the pin.
100	21 10	.....do.....	740	1 strand at the pin.

No. 4 SHOT LINES

Diameter, ".14.

Three strands of 4 threads each.

Lay one turn in ".68.

Tested in 4-foot lengths.

No. of test.	Weight of coil.	End of coil tested.	Tensile strength.	Parted.
	<i>Lbs. ocs.</i>		<i>Pounds.</i>	
101	10 11	Outside...	331	2 strands 2' from pin.
102	10 9½	.....do.....	342	1 strand 2' from pin.
103	10 6	.....do.....	397	1 strand 12" from pin.
104	10 5½	.....do.....	386	3 strands at the pin.
105	10 6	.....do.....	393	Do.
106	10 9	.....do.....	398	1 strand 2' from pin.
107	10 9	Inside.....	379	3 strands at the pin.
108	10 6½	Outside.....	367	1 strand at the pin.
109	10 8	.....do.....	406	3 strands at the pin.
110	10 9½	.....do.....	402	3 strands 18" from pin.
111	10 9	Inside.....	392	1 strand at the pin.
112	10 10	Outside.....	401	2 strands 20" from pin.
113	10 9½	.....do.....	398	3 strands 8" from pin.
114	10 6	.....do.....	363	1 strand 2' from pin.
115	10 5½	.....do.....	352	1 strand at the pin.
116	10 9	.....do.....	366	3 strands at the pin.
117	10 10	.....do.....	378	1 strand 12" from pin.
118	10 10	.....do.....	318	1 strand 2' from pin.
119	10 6½	.....do.....	340	1 strand 9" from pin.
120	10 9½	.....do.....	377	1 strand 14" from pin.
121	10 7	.....do.....	400	1 strand 2' from pin.
122	10 6½	.....do.....	367	3 strands at the pin.
123	10 6½	.....do.....	364	Do.
124	10 9½	.....do.....	374	3 strands 12" from pin.
125	10 8½	.....do.....	394	1 strand 2' from pin.
126	10 9	.....do.....	406	2 strands 2' from pin.
127	10 8½	.....do.....	361	Do.
128	10 10	.....do.....	367	3 strands 5" from pin.
129	10 9½	.....do.....	400	1 strand 12" from pin.
130	10 10	.....do.....	355	3 strands 2' from pin.
131	10 10½	Inside.....	377	1 strand at pin.
132	10 7½	.....do.....	393	1 strand 2' from pin.
133	10 9	Outside.....	382	3 strands 5" from pin.
134	10 7	.....do.....	374	1 strand 19" from pin.
135	10 8½	.....do.....	406	2 strands 2' from pin.
136	10 6½	.....do.....	351	1 strand 13" from pin.
137	10 9½	Inside.....	390	1 strand 14" from pin.
138	10 7	Outside.....	377	3 strands at the pin.
139	10 7½	Inside.....	376	3 strands 12" from pin.
140	10 6½	Outside.....	377	2 strands 3" from pin.
141	10 10½	.....do.....	388	1 strand 2' from pin.
142	10 9½	.....do.....	400	1 strand 8" from pin.
143	10 9	.....do.....	404	3 strands at the pin.
144	10 7	Inside.....	356	Do.
145	10 6	Outside.....	369	1 strand 18" from pin.
146	10 9	.....do.....	400	2 strands at the pin.
147	10 6½	.....do.....	401	3 strands 12" from pin.
148	10 7	.....do.....	396	3 strands 17" from pin.
149	10 7½	.....do.....	375	3 strands 2' from pin.
150	10 8	.....do.....	340	3 strands at the pin.

No. 10569.

MANILA AND HEMP ROPE.

From Third Light-house District, Tompkinsville, N. Y.
 Samples prepared for testing with eye splices at the ends.
 Length between splices, from 21" to 34".

Description.	Tensile strength.	Parted.
	<i>Pounds.</i>	
15-thread Manila.....	1,620	1 strand at the splice.
Do	1,810	Do.
18-thread Manila.....	2,720	Do.
Do	2,710	Do.
21-thread Manila.....	3,250	Do.
Do	3,250	Do.
3-inch hemp	6,960	Do.
Do	6,860	Do.

No. 10594.

Length between splices, from 26" to 31".

Description.	Tensile strength.	Parted.
	<i>Pounds.</i>	
15-thread Manila.....	1,230	1 strand at the splice.
Do	1,240	Do.
Do	1,810	Do.
Do	1,320	Do.
3-inch Manila.....	4,920	Do.
Do	5,200	1 strand 3" from the splice.
Do	6,150	1 strand at the splice.

No. 10643.

Length between splices, from 32" to 34".

Description.	Tensile strength.	Parted.
	<i>Pounds.</i>	
15-thread manila	1,720	1 strand 3" from the splice.
Do	1,890	1 strand at the splice.
Do	1,704	Do.
3-inch hemp	5,840	Do.
Do	5,220	1 strand 6" from the splice.
Do	5,320	1 strand at the splice.

No. 10544.

COIR ROPE.

Received from Sandy Hook proving ground.

Tensile test.

Number of strands.....	.....	4
Diameter.....	inches.....	1.85
Circumference.....	do.....	5.75
Lay one turn in.....	do.....	4.5
Length, about.....	feet.....	20.5
Weight, total.....	pounds.....	9.78
Weight, per fathom.....	do.....	2.86

Sample prepared with eye splices at the ends. Length between splices, 6 feet.

Tensile strength, 3,700 pounds.

Parted three strands at the splice.

PAPER.

No. 10646.

TENSILE TESTS OF BLUE-PRINT AND BROWN-PRINT PAPERS FOR THE ORDNANCE DEPARTMENT, U. S. ARMY.

Specimens taken longitudinally.

Dimensions of specimens, 1" by 3".

Three tests were made from each sample.

BLUE-PRINT PAPER.

Marks.	Thick-ness.	Tensile strength.			
		1st.	2d.	3d.	Mean.
	<i>Inch.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1.....	.0041	40	88	41	39.7
2.....	.0041	30	30	26	28.7
3.....	.0340	30	27	30	29
4.....	.0041	18.5	26	26.5	27
5.....	.0038	51.5	52	51	51.5
6.....	.0046	46	47	46	46.3
14.....	.0044	41	30.5	40	40.2

BROWN-PRINT PAPER.

7.....	.0026	30	29.5	29	29.5
8.....	.0045	20	22.5	20	20.8
9.....	.0044	28.5	29	31.5	29.7
10.....	.0034	35.5	35	35	35.2
11.....	.0044	42.5	41.5	42.5	42.2
12.....	.0025	25	27	25.5	25.8
13.....	.0040	34.5	33.5	36	34.7
15.....	.0036	31	33	30	31.3
16.....	.0026	12	13	12	12.3
17.....	.0037	22	21	21	21.3

Following are tensile tests made on duplicate samples of the above papers, Nos. 1 to 14, inclusive, after washing and drying according to the usual treatment given this class of material in service.

BLUE-PRINT PAPER.

[After washing and drying.]

Marks.	Thick-ness.	Tensile strength.			
		1st.	2d.	3d.	Mean.
	<i>Inch.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1.....	.0043	40	40	39	39.7
2.....	.0044	27	27.5	27	27.2
3.....	.0046	27	27.5	26.5	26.7
4.....	.0047	24.5	25	23	24.2
5.....	.0042	44.5	48	44	45.5
6.....	.0063	39	38	44.5	40.5
14.....	.0048	35	37	35	35.7

BROWN-PRINT PAPER.

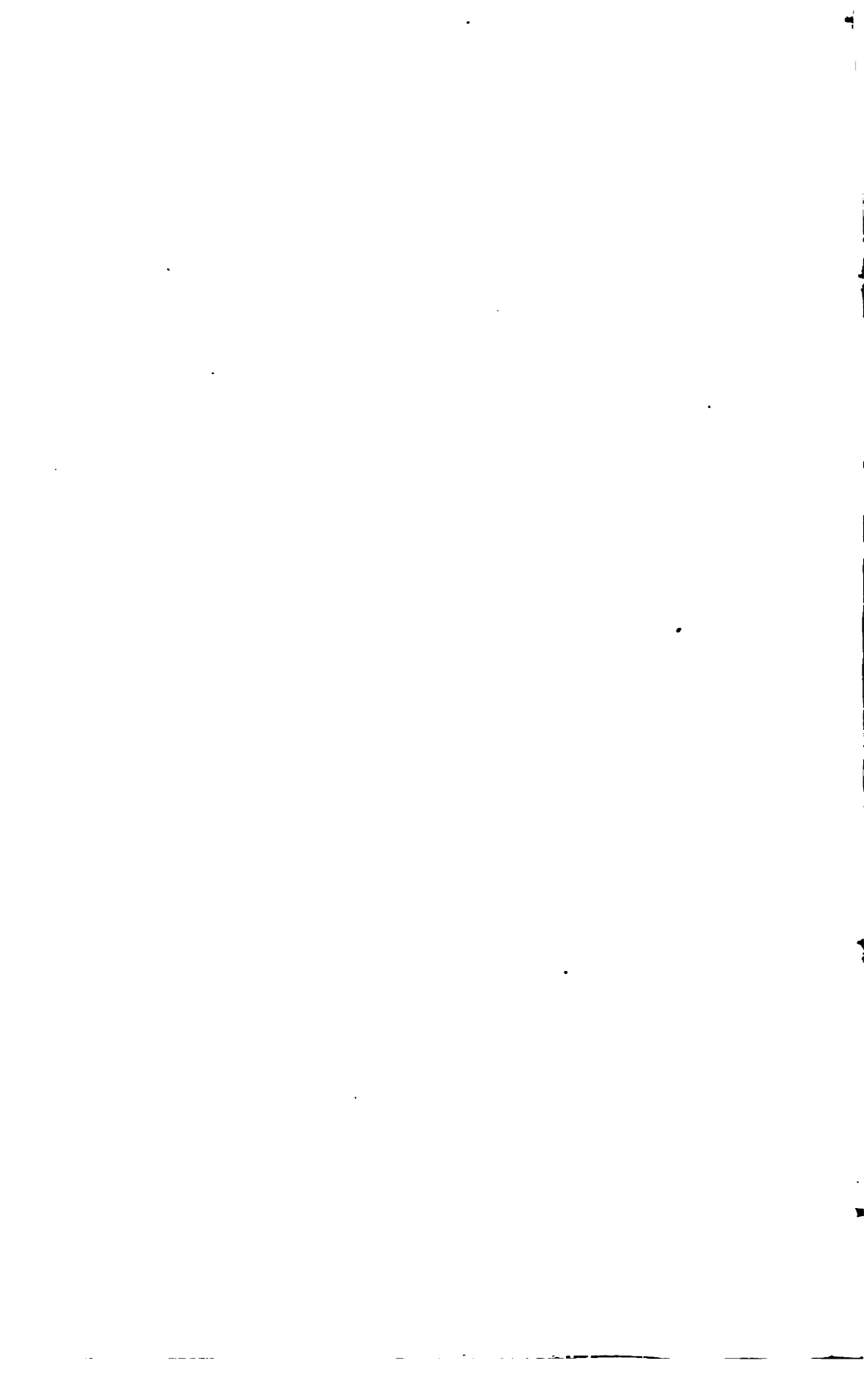
[After washing and drying.]

7.....	.0028	26.5	28	25.5	26.3
8.....	.0045	18	19.5	17.5	18.3
9.....	.0047	32	29.5	30.5	30.7
10.....	.0034	31.5	32	32	31.8
11.....	.0045	41	43	40	41.3
12.....	.0025	23	22	22	22.3
13.....	.0043	33	30	32	31.7

GENERAL AVERAGES.

	Pounds.
Blue-print paper, original.....	37.
Blue-print paper, after washing and drying.....	34.
Brown-print paper, original.....	28.
Brown-print paper, after washing and drying.....	28.

BRICKS.



BRICKS.

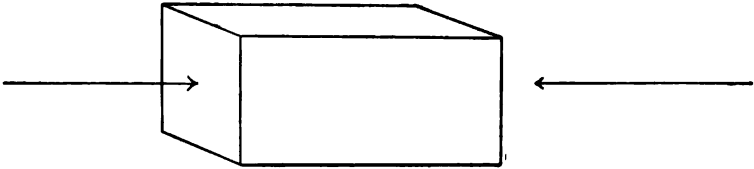
ABSORPTION OF WATER AND ELASTIC PROPERTIES.

DRY PRESSED AND MUD BRICKS FROM DIFFERENT PARTS OF A DOWN-DRAFT KILN.

The two kinds of brick, made from the same clay, were burned side by side in the respective parts of the kiln mentioned.

Bricks immersed in water four months, after which they were taken out and tested while in a saturated state.

Material furnished by Messrs Fiske & Co., Boston, Mass.



No. 1502.

DRY PRESSED BRICK.

Shade 11, from top of kiln.

Original weight, dry, 5 pounds 15 $\frac{1}{4}$ ounces = 131.2 pounds per cubic foot.

Total weight when tested, 6 pounds 7 $\frac{1}{4}$ ounces = 142.2 pounds per cubic foot.

Water absorbed, by weight 8.4 per cent; by volume 17.6 per cent.

Length, 8".09.

Sectional area, 2".43 \times 4".01 = 9.74 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
974	100	0.	0.	Initial load.
1,948	200	0.	0.	
3,896	400	.0002	.....
5,844	600	.0004	.....
7,792	800	.0006	.....
9,740	1,000	.0008	0.	
19,480	2,000	.0017	0.	
29,220	3,000	.0029	0.	
38,960	4,000	.0042	.0001	
48,700	5,000	.0057	.0002	
58,440	6,000	.0071	.0003	
68,180	7,000	.0085	.0003 +	
77,920	8,000	.0100	.0005	E (1,000-3,000) = 4,762,000 pounds per square inch.
110,100	11,300	E (1,000-8,000) = 4,028,000 pounds per square inch. Ultimate strength.

No. 1503.

DRY PRESSED BRICK.

Shade 7, from one-third down the kiln.

Original weight, dry, 5 pounds $13\frac{1}{4}$ ounces = 126.8 pounds per cubic foot.Total weight when tested, 6 pounds $6\frac{1}{4}$ ounces = 138.6 pounds per cubic foot.

Water absorbed, by weight, 9.4 per cent; by volume, 19 per cent.

Length, 8".06.

Sectional area, $2'' \times 3'' \times .99 = 9.89$ square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
889	100	0.	0.	Initial load.
1,978	200	0.	.....
3,966	400	.0001	.....
5,934	600	.0004	.....
7,912	800	.0006	.....
9,890	1,000	.0008	0.	
19,780	2,000	.0023	0.	
29,670	3,000	.0041	0.	E (1,000-3,000) = 3,080,000 pounds per square inch.
39,560	4,000	.0068	.0001	E (1,000-7,000) = 2,913,000 pounds per square inch. Ultimate strength.
49,450	5,000	.0076	.0001	
59,340	6,000	.0096	.0001	
69,230	7,000	.0114	.0008	
76,000	7,680	.....	.....

No. 1504.

DRY PRESSED BRICK.

Shade 2, from two-thirds down the kiln.

Original weight, dry, 5 pounds 12½ ounces = 123.3 pounds per cubic foot.

Total weight when tested, 6 pounds 7½ ounces = 137.3 pounds per cubic foot.

Water absorbed, by weight, 11.3 per cent; by volume, 22.4 per cent.

Length, 8".19.

Sectional area, 2".48 × 4" = 9.92 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load. E(1,000-3,000) = 2,128,000 pounds persquare Inch. E(1,000-5,000) = 2,198,000 pounds persquare Inch. Ultimate strength.
992	100	0.	0.	
1,984	200	.0008	-----	
3,968	400	.0010	-----	
5,952	600	.0017	-----	
7,936	800	.0023	-----	
9,920	1,000	.0028	0.	
19,840	2,000	.0053	.0002	
29,760	3,000	.0078	.0008	
39,680	4,000	.0100	.0006	
49,600	5,000	.0125	.0006	
50,500	5,090	-----	-----	

No. 1505.

DRY PRESSED BRICK.

Shade 06, from bottom of kiln.

Original weight, dry, 5 pounds 13 ounces = 117 pounds per cubic foot.

Total weight when tested, 6 pounds 11½ ounces = 134.9 pounds per cubic foot.

Water absorbed, by weight, 15.3 per cent; by volume, 28.7 per cent.

Length, 8".47.

Sectional area, 2".53 × 4".01 = 10.14 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load. E(1,000-2,000) = 1,042,000 pounds per square Inch. Ultimate strength.
1,014	100	0.	0.	
2,028	200	.0004	-----	
4,056	400	.0012	-----	
6,084	600	.0020	-----	
8,112	800	.0029	-----	
10,140	1,000	.0038	0.	
20,280	2,000	.0090	.0004	
24,600	2,430	-----	-----	

No. 1506.

MUD BRICK.

Shade 8, from top of kiln.

Original weight, dry, 6 pounds 2 ounces=141.8 pounds per cubic foot.

Total weight when tested, 6 pounds 5½ ounces=146.5 pounds per cubic foot.

Water absorbed, by weight, 3.3 per cent; by volume, 7.5 per cent.

Length, 7".98.

Sectional area, 2".38 × 3".93=9.35 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load. E (1,000-3,000)=6,667,000 pounds per square inch. E (1,000-10,000)=7,258,000 pounds per square inch. Ultimate strength.
935	100	0.	0.	
1,870	200	.0001	.....
3,740	400	.0006	.....
5,610	600	.0006	.....
7,480	800	.0006	.....
9,350	1,000	.0010	0.	
18,700	2,000	.0018	0.	
28,050	3,000	.0026	0.	
37,400	4,000	.0032	0.	
46,750	5,000	.0039	0.	
56,100	6,000	.0045	0.	
65,450	7,000	.0052	0.	
74,800	8,000	.0059	0.	
84,150	9,000	.0066	0.	
93,500	10,000	.0072	0.	
157,200	16,810	.....	.....

No. 1507.

MUD BRICK

Shade 5, from one-fourth down the kiln.

Original weight, dry, 6 pounds 1 ounce = 136.5 pounds per cubic foot

Total weight when tested, 6 pounds 6¼ ounces = 144.3 pounds per cubic foot.

Water absorbed, by weight, 5.7 per cent; by volume, 12.4 per cent

Length, 8".09.

Sectional area, 2".37 × 4" = 9.48 square inches.

Gauged length, 5".

Applied loads		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
948	100	0.	0.	Initial load.
1,896	200	.0002	.....
3,792	400	.0005	.....
5,688	600	.0008	.....
7,584	800	.0010	.....
9,480	1,000	.0012	0.	
18,960	2,000	.0021	0.	
28,440	3,000	.0030	0.	E (1,000-3,000) = 5,566,000 pounds per square inch.
37,920	4,000	.0037	0.	
47,400	5,000	.0045	0.	
56,880	6,000	.0052	0.	
66,360	7,000	.0060	0.	
75,840	8,000	.0068	0.	E (1,000-8,000) = 6,250,000 pounds per square inch.
157,100	16,570	.....	.....	Ultimate strength.

No. 1508.

MUD BRICK.

Shade 2, from two-thirds down the kiln.

Original weight, dry, 6 pounds 2 ounces = 131.4 pounds per cubic foot.

Total weight when tested, 6 pounds 10½ ounces = 142.8 pounds per cubic foot.

Water absorbed, by weight, 8.7 per cent; by volume, 18.3 per cent.

Length, 8".13.

Sectional area, 2".46 × 4".03 = 9.91 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load. E (1,000-7,000) = 5,882,000 pounds per square inch. Ultimate strength.
991	100	0.	0.	
1,982	200	.0001	.....
3,964	400	.0003	.....
5,946	600	.0005	.....
7,928	800	.0008	.....
9,910	1,000	.0010	0.	
19,820	2,000	.0020	0.	
29,730	3,000	.0030	.0001	
39,640	4,000	.0040	.0003	
49,550	5,000	.0049	.0006	
59,460	6,000	.0060	.0008	
69,370	7,000	.0071	.0010	
107,100	10,810	.....	.....

No. 1509.

MUD BRICK.

Shade 03, from bottom of kiln.

Original weight, dry, 6 pounds $5\frac{1}{4}$ ounces = 126.1 pounds per cubic foot.

Total weight when tested, 7 pounds 1 ounce = 140.4 pounds per cubic foot.

Water absorbed, by weight, 11.3 per cent; by volume, 22.9 per cent.

Length, 8".34.

Sectional area, $2''.52 \times 4''.14 = 10.43$ square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1, 043	100	0.	0.	Initial load.
2, 086	200	.0001		
4, 172	400	.0004		
6, 258	600	.0006		
8, 344	800	.0007		
10, 430	1, 000	.0010	0.	
20, 860	2, 000	.0020	.0001	
31, 290	3, 000	.0033	.0001	E (1,000-3,000) = 4,545,000 pounds per square inch.
41, 720	4, 000	.0046	.0001	
52, 150	5, 000	.0060	.0004	
62, 580	6, 000	.0076	.0006	
73, 010	7, 000	.0090	.0007	E (1,000-7,000) = 4,110,000 pounds per square inch.
95, 100	9, 120			Ultimate strength.

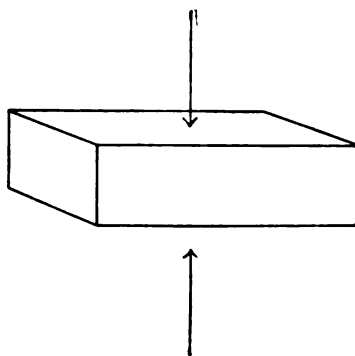
TABLATION OF ABSORPTION OF WATER, ELASTIC PROPERTIES, AND COMPRESSIVE STRENGTH OF DRY PRESSED AND MUD BRICKS.

Bricks were immersed in water four months, after which they were taken out and tested while in a saturated state. Loaded endwise. Gauged length, 5".

No. of test.	Kind of brick.	Shade.	Position in kiln.	Weights.		Water absorbed.		Modulus of elasticity.		Permanent set after loads per square inch of—		Compressive strength per square inch.
				Original weight per cubic foot, dry.	Total weight per cubic foot when tested.	By weight.	By volume.	Between loads per square inch of 1,000 and 8,000.	At highest stress observed.	1,000.	8,000.		5,000.
				Pounds.	Pounds.	Per cent.	Per cent.	Pounds.	Pounds.	Inch.	Inch.	Pounds.
1502	Dry pressed.....	11	Top.....	131.2	142.2	8.4	17.6	4,762,000	4,023,000	0.	0.	11,300
1503	do.....	7	One-third down.....	126.8	138.6	9.4	19.0	8,030,000	2,913,000	0.	0.	7,680
1504	do.....	2	Two-thirds down.....	123.3	137.3	11.3	22.4	2,128,000	2,198,000	0.	0.	5,080
1505	do.....	06	Bottom.....	117.0	134.9	15.3	28.7	2,194,000	.....	0.	0.	2,480
1506	Mud.....	8	Top.....	141.8	146.5	3.3	7.5	6,667,000	7,258,000	0.	0.	16,810
1507	do.....	5	One-fourth down.....	136.5	144.3	6.7	12.4	5,556,000	6,250,000	0.	0.	16,570
1508	do.....	2	Two-thirds down.....	131.4	142.8	8.7	18.3	5,288,000	5,892,000	0.	0.	10,810
1509	do.....	03	Bottom.....	126.1	140.4	11.3	22.9	4,545,000	4,110,000	0.	0.	9,120

^a Between 1,000 and 2,000.

COMPRESSION TESTS.



Compressed surfaces faced with neat Portland cement. Loaded flatwise.

DRY PRESSED BRICKS.

Shade and location in kiln.	Dimensions.				Sectional area.	First crack.	Ultimate strength.	
	Height.	Compressed surface.		Total.			Per square inch.	
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. inches.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	
Shade 11, top	2.43	4.00	8.19	32.76	337,000	494,600	15,100	
Do.....	2.44	4.05	8.21	33.25	443,000	543,000	16,330	
Shade 7, one-third down ...	2.47	3.95	8.31	32.82	332,000	381,000	11,610	
Do.....	2.46	3.94	8.31	32.74	353,000	396,500	12,110	
Shade 2, two-thirds down ..	2.50	3.96	8.39	33.22	275,000	342,000	10,300	
Do.....	2.48	3.93	8.38	32.93	305,000	341,000	10,360	
Shade 06, bottom	2.52	4.04	8.50	34.34	221,000	231,800	6,750	

MUD BRICKS.

Shade 8, top	2.35	3.96	8.05	31.88	199,000	365,000	11,450
Do.....	2.33	3.89	8.02	31.20	192,000	353,000	11,310
Shade 5, one-fourth down ..	2.38	3.96	8.13	32.19	181,000	459,000	14,260
Do.....	2.40	3.95	8.11	32.03	105,000	354,000	11,050
Shade 2, two-thirds down ..	2.49	4.05	8.30	33.62	150,000	397,500	11,820
Do.....	2.47	4.04	8.37	33.81	188,000	396,000	11,710
Shade 03, bottom	2.51	4.14	8.55	35.40	96,000	291,000	8,220
Do.....	2.51	4.16	8.54	35.53	122,000	331,000	9,320



CEMENT.



CEMENTS WHICH SET IN AIR AT DIFFERENT TEMPERATURES.

COMPRESSION TESTS OF SPECIMENS WHICH SET IN AIR AT 0° F., PRECEDED BY DIFFERENT INTERVALS AT 70° F., AND FOLLOWED BY ONE DAY AT 70° F., WITH CUBES OF THE SAME COMPOSITION WHICH AGED IN AIR AT 70° F. ONLY, CORRESPONDING INTERVALS OF TIME.

[See Report 1902, p. 389, for earlier tests of this series.]

Marks.	Brand of cement.	Composition.			Time of setting in air at temperatures of—			Dimensions.			Sec-tional area.	Compressive strength.			Remarks.		
		Ce-ment.	Sand.	Water.	70° F.	0° F.	70° F.	Height.	Compressed surface.	Sq. in.		Total.	Per square inch.	Mean.			
Alp. F. 20.....	Alpha.....	Neat.	Per ct. 25.0	Days. 366	Days. 366	Days. 1	1.99	1.97	1.98	1.97	2.00	2.00	2.00	21,700	5,480	Pounds. 5,710
								2.00	1.97	2.00	1.97	2.00	2.00	2.00	21,700	5,480	
								2.04	1.92	2.00	1.98	2.00	2.00	2.00	21,700	5,480	
								2.02	2.00	2.00	1.98	2.00	2.00	2.00	26,300	6,640	
								2.04	1.98	2.00	1.97	2.00	2.00	2.00	18,300	8,500	
								1.97	1.99	2.00	1.97	2.00	2.00	2.00	11,400	2,860	
Alp. Mar. 8.....	Alpha.....	Neat.	25.0	371	2.00	1.98	2.00	1.98	2.00	2.00	2.00	81,200	7,570	Pounds. 8,180	
							2.01	2.02	2.04	2.04	2.02	2.04	2.04	24,300	6,140		
							2.00	2.04	2.04	1.98	2.00	2.04	2.00	22,600	5,480		
							2.00	2.00	2.00	2.01	2.00	2.01	2.00	24,700	6,110		
							2.00	2.00	2.00	2.01	2.00	2.01	2.00	21,100	5,260		
							2.02	1.98	2.00	1.98	2.01	2.01	2.02	20,100	5,060		
Alp. Apr. 26.....	Alpha.....	Neat.	25.0	396	2.03	2.04	2.02	1.97	2.00	2.00	2.00	5,380	5,380	Pounds. 5,690	
							2.01	2.03	2.03	1.97	2.02	2.02	2.02	28,900	6,990		
							2.03	2.07	2.07	1.96	2.00	2.07	2.03	18,200	4,550		
							2.03	2.07	2.07	1.96	2.00	2.07	2.03	23,700	5,840		
							2.03	2.05	2.02	2.00	1.97	2.00	2.03	21,500	5,380		
							2.01	2.03	2.03	1.96	2.02	2.02	2.02	28,900	6,990		
Alp. Apr. 26.....	Alpha.....	Neat.	25.0	397	1	2.03	2.05	2.06	2.00	1.97	2.00	2.00	5,410	5,410	Pounds. 5,690	
							2.01	2.05	2.06	2.00	1.96	2.00	2.00	22,400	5,880		
							2.05	2.06	2.06	2.00	1.97	2.00	2.05	20,000	4,880		
							2.05	2.06	2.06	2.00	1.97	2.00	2.05	20,000	4,880		
							1.98	1.99	2.03	2.03	1.97	2.00	1.98	27,100	7,710		
							2.03	2.05	2.06	2.00	1.96	2.00	2.03	27,100	7,710		

COMPRESSION TESTS OF SPECIMENS WHICH SET IN AIR AT 90° F., PRECEDED BY DIFFERENT INTERVALS AT 70° F., AND FOLLOWED BY ONE DAY AT 70° F., WITH CUBES OF THE SAME COMPOSITION WHICH AGED IN AIR AT 70° F. ONLY, CORRESPONDING INTERVALS OF TIME—Continued.

Marks.	Brand of cement.	Composition.			Time of setting in air at temperatures of—			Dimensions.		Sectional area.	Compressive strength.			Remarks.			
		Cement.	Sand.	Water.	70° F.	90° F.	70° F.	Height.	Compressed surface.		Total.	Per square inch.	Mean.				
Atl. F. 27.....	Atlas.....	Neat.	.....	Per. cl. 24.0	Days, 366	.....	.....	.....	.....	.....	.....	Pounds.	Pounds.	Pounds.			
												2,00	2.05		4.14	28,800	6,840
												2.02	2.00		4.04	23,800	5,770
												2.02	2.08		4.06	27,200	6,700
												1.94	2.00		4.02	26,100	6,490
												.....	2.01		.....	.....	6,450
Atl. Mar. 13.....	Atlas.....	Neat.	.....	24.0	1	364	.....	.....	.....	.....	.....	12,200	8,080	3,200			
												2.01	1.99		2.02	10,500	2,650
												2.02	2.04		3.96	18,800	3,870
												2.00	2.02		4.10	12,800	3,010
												1.99	2.02		4.08	12,800	3,010
												1.98	2.01		4.06	16,000	3,940
Atl. Mar. 12.....	Atlas.....	Neat.	.....	23.5	373	.....	.....	.....	.....	.....	.....	22,000	5,390	5,300			
												2.04	2.00		2.04	26,000	6,400
												1.96	1.98		2.05	18,000	4,810
												2.02	2.05		2.04	21,200	5,250
												1.98	1.97		2.05	21,800	5,140
												2.01	2.08		2.04	20,100	4,900
Atl. Mar. 12.....	Atlas.....	Neat.	.....	23.5	4	368	.....	.....	.....	.....	.....	18,000	4,480	4,820			
												2.02	1.99		2.02	19,400	4,780
												2.02	2.00		2.08	19,200	4,950
												2.04	1.92		2.02	20,100	4,980
												1.95	1.98		2.04	20,800	5,150
												.....	2.05		.....	.....	5,150
Atl. Mar. 12.....	Atlas.....	Neat.	.....	24.0	374	.....	.....	.....	.....	.....	.....	21,600	5,270	5,390			
												2.03	2.01		2.04	20,200	5,100
												2.03	1.98		2.00	21,000	5,170
												2.00	2.00		2.08	21,000	5,170
												2.04	2.01		2.00	25,100	6,240
												.....	2.00		.....	.....	6,240
Atl. Mar. 12.....	Atlas.....	Neat.	.....	24.0	7	346	1	.....	.....	.....	.....	20,400	5,000	5,040			
												2.00	2.04		2.01	19,800	4,710
												2.01	2.00		2.02	16,500	4,580
												1.99	1.99		2.08	21,200	5,250
												1.98	1.98		2.02	21,600	5,250
												.....	1.98		2.02	.....	5,040

COMPRESSION TESTS OF SPECIMENS WHICH SET IN AIR AT 0° F., PRECEDED BY DIFFERENT INTERVALS AT 70° F., AND FOLLOWED BY ONE DAY AT 70° F., WITH CUBES OF THE SAME COMPOSITION WHICH AGED IN AIR AT 70° F. ONLY, CORRESPONDING INTERVALS OF TIME—Continued.

Marks.	Brand of cement.	Composition.			Time of setting in air at temperatures of—			Dimensions.			Sec- tional area.	Compressive strength.			Remarks.						
		Ce- ment.	Sand.	Water.	70° F.	0° F.	70° F.	Height.	Compressed surface.	Inches.		Total.	Per square inch.	Mean.							
N. & R. F. 26...	Newark and Rosen- dale.	Neat.	38.0	38.0	Days.	Days.	Days.	Inches.	Inches.	Inches.	Sq. ins.	Pounds.	Pounds.	Pounds.							
					367			2.02	2.02	2.06	4.10	7,200	1,760								
								2.04	2.02	2.04	4.12	8,400	2,040								
								2.02	2.02	2.03	4.10	5,600	1,370								
								2.01	2.02	2.07	4.18	5,600	1,340								
								2.00	2.00	2.04	4.08	7,700	1,880	1,680							
N. & R. Mar. 11.	Newark and Rosen- dale.	Neat.	38.1	38.1	Days.	Days.	Days.	Inches.	Inches.	Inches.	Sq. ins.	Pounds.	Pounds.	Pounds.							
					875		1	1.98	2.00	2.04	4.08	9,200	2,250								
								2.02	1.99	2.06	4.10	8,600	2,100								
								2.02	1.98	2.04	4.04	8,500	2,100								
								1.97	1.98	2.04	4.08	6,900	1,600								
								2.00	1.98	2.07	4.10	5,750	1,400	1,910							
					N. & R. May 1.	Newark and Rosen- dale.	Neat.	38.1	38.1	Days.	Days.	Days.	Inches.	Inches.		Inches.	Sq. ins.	Pounds.	Pounds.	Pounds.	
										892		1	2.00	2.06		2.02	4.16	8,300	798		
													2.02	2.05		2.06	4.18	4,500	1,077		
													2.00	2.04		2.05	4.18	8,400	813		
													2.04	2.02		2.07	4.18	8,800	909		
													2.03	2.04		2.06	4.20	5,200	1,238	965	
N. & R. May 1.	Newark and Rosen- dale.	Neat.	38.1	38.1	Days.	Days.	Days.	Inches.	Inches.	Inches.	Sq. ins.	Pounds.	Pounds.	Pounds.							
					7		1	2.00	2.01	2.02	4.06	8,700	910								
								2.01	2.02	2.02	4.14	7,600	1,840								
								2.04	2.05	2.08	4.10	6,000	1,460								
								1.96	2.00	2.04	4.08	6,500	1,560								
								2.05	2.00	2.01	4.02	5,200	1,290	1,420							
N. & R. May 1.	Newark and Rosen- dale.	Neat.	38.1	38.1	Days.	Days.	Days.	Inches.	Inches.	Inches.	Sq. ins.	Pounds.	Pounds.	Pounds.							
					383		1	1.96	2.01	1.97	3.96	4,460	1,130								
								1.96	2.02	2.08	4.10	4,600	1,120								
								1.99	1.99	2.02	4.02	4,000	1,000								
								1.99	2.07	2.06	4.26	5,100	1,200								
								2.02	2.08	2.00	4.16	5,680	1,370	1,160							

CEMENT AND MORTAR CUBES.

COMPARATIVE TESTS ON MATERIAL SET IN AIR AND IN WATER.

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, EXCEPTING THE FIRST DAY AFTER MIXING, WHICH WAS IN AIR.

[See report 1902, p. 422, for earlier tests of this series.]

Marks.	Brand of cement.	Composition.		Age in—		Dimensions.			Compressive strength.		Remarks.		
		Ce-ment.	Sand.	Water.	Air.	Water.	Air.	Height.	Compressed surface.	Sec-tional area.		Total.	Per square inch.	Mean.
Atl. J. 9.	Atlas	1	1	Per ct. 32.0	Days. 226	Days.	Days.	Inches.	Inches.	Sq. ins.	Pounds.	Pounds.	
								3.02	3.04	9.30	49,100	5,280	
								3.00	3.06	9.30	50,800	5,460	
								3.03	3.07	9.24	49,600	5,370	
								2.99	3.02	9.15	47,600	5,200	
								3.05	3.01	9.18	48,000	5,250	5,310
		1	1	32.0	226			4.02	4.09	16.40	79,500	4,860	4,860
		1	1	32.0	1	191	34	3.05	3.07	9.36	79,900	8,540	
		1	1	32.0	1			3.04	3.08	9.16	84,700	8,960	
								3.03	3.00	9.15	82,700	8,900	
								3.02	3.02	9.24	87,000	9,170	
								3.02	3.03	9.39	80,500	8,570	8,280
Atl. J. 10.		1	1	33.7	1	190	34	4.05	4.00	15.92	124,100	7,800	7,800
L. J. 14	Lehigh			27.0	186			1.98	2.02	4.14	26,400	6,980	
								2.02	2.01	4.06	19,200	4,780	
								2.00	2.04	4.10	21,800	5,320	
								2.00	1.98	4.08	25,500	6,580	
								2.02	2.00	4.12	21,400	5,190	5,680
								2.05	1.99	4.14	29,950	7,280	
				27.0	1	185		1.91	2.02	4.06	32,200	7,980	
								2.01	2.09	4.26	27,400	6,480	
								2.00	2.02	4.10	35,850	8,740	
								2.08	2.02	4.14	29,200	7,060	7,480
L. J. 15.	Lehigh	1	1	34.0	185			1.99	1.97	4.12	13,300	3,280	
								2.00	2.00	4.18	13,400	3,210	
								2.00	2.00	4.24	11,900	2,810	
								2.07	1.98	4.06	14,600	3,560	
								2.03	1.90	3.88	13,250	3,410	3,240

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, EXCEPTING THE FIRST DAY AFTER MIXING, WHICH WAS IN AIR—Continued.

Marks.	Brand of cement.	Composition.			Age in—			Dimensions.			Sec-tional area.	Compressive strength.			Remarks.
		Ce-ment.	Sand.	Water.	Air.	Water.	Air.	Height.	Compressed surface.	Total.		Per square inch.	Mean.		
L. J. 15.....	Lehigh.....	1	1	Per ct. 34.0	Days. 1	Days. 164	.....	Inches. 1.97 1.98 2.02 2.07 2.01	Inches. 2.10 2.05 2.06 2.07 2.09	Sq. ins. 4.14 4.08 4.10 4.14 4.20	Pounds. 22,060 22,300 24,950 21,600 24,600	Pounds. 5,330 5,470 6,090 5,220 5,860	.....	.....
Pen. J. 11.....	Peninsular.....	1	1	34.2	224	.....	.....	3.00 3.00	3.02 3.04	9.06 9.12	56,700 59,100	6,260 6,480	.....	.....
		1	1	34.2	224	.....	.....	4.00 4.08	4.07 3.92	16.12 15.68	91,700 93,900	5,630 5,990	.....	.....
		1	1	34.2	224	.....	.....	6.00	5.98	35.88	217,500	6,060	.....	.....
		1	1	34.2	1	187	36	3.02 3.06 3.04	3.02 3.01 3.01	9.12 9.18 9.24	111,000 110,800 102,100	12,170 12,070 11,060	.....	.....
		1	1	34.2	1	187	36	4.11 4.02	4.01 3.98	15.80 15.96	168,500 162,000	10,660 10,150	.....	.....
		1	1	34.2	1	187	36	6.08	5.99	35.58	372,000	10,460	.....	.....
		1	2	48.1	228	.....	.....	3.03 3.07 3.00 3.06 3.00 3.02	3.16 3.02 3.02 3.01 3.08 3.08	9.51 9.61 9.80 9.27 9.42 9.34	28,100 31,200 31,900 80,100 31,300 31,400	2,950 3,260 3,370 3,250 3,820 3,400	.....	.....
		1	2	48.1	228	4.04 4.00 4.07 4.02	4.00 4.12 4.00 4.00	15.92 16.40 16.00 15.88	49,900 47,400 60,000 49,700	3,180 2,990 3,125 3,130	
Pen. J. 12.....	Peninsular.....	1	2	48.1	228	5.98	6.08	36.60	116,300	3,190	

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CEMENT.

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, EXCEPTING THE FIRST DAY AFTER MIXING, WHICH WAS IN AIR.—Continued.

Marks.	Brand of cement.	Composition.			Age in—		Dimensions.		Sectional area.	Compressive strength.			Remarks.					
		Ce-ment.	Sand.	Water.	Air.	Water.	Air.	Height.		Compressed surface.	Total.	Per square inch.		Mean.				
Pen. J. 14.....	Peninsular	1	4	Per ct.	1	35	3.99	4.00	16.20	Pounds.	2,940	Pounds.						
				87.0										Days.	4.00	4.00	47,700	
				186										Days.	3.02	4.00	51,800	
														35	Days.	4.09	4.00	51,700
															Days.	3.79	4.00	51,800
O. J. 80.....	Obelisk.....	1	4	Per ct.	1	35	5.97	6.04	36.48	Pounds.	2,160	Pounds.						
				42.0										Days.	2.02	2.08	9,700	
				197										Days.	1.94	2.08	9,000	
														1	Days.	2.00	2.08	8,600
															Days.	2.02	2.08	10,560
G. J. 2.....	Cathedral.....	1	1	Per ct.	1	197	2.02	2.04	4.14	Pounds.	1,880	Pounds.						
				42.0										Days.	2.04	2.06	8,100	
				1										Days.	2.05	2.06	8,450	
														1	Days.	2.02	2.06	7,700
															Days.	2.08	2.06	7,100
G. J. 3.....	Cathedral.....	1	1	Per ct.	1	194	1.98	2.00	4.02	Pounds.	3,280	Pounds.						
				28.8										Days.	2.00	2.06	13,000	
				1										Days.	2.02	2.04	14,700	
														1	Days.	2.02	2.04	14,900
															Days.	2.01	2.01	14,400
G. J. 3.....	Cathedral.....	1	1	Per ct.	1	196	2.01	2.06	4.12	Pounds.	2,940	Pounds.						
				28.8										Days.	2.02	2.06	8,400	
				1										Days.	2.08	2.04	8,220	
														1	Days.	2.08	2.06	8,780
															Days.	2.02	2.04	15,200
G. J. 3.....	Cathedral.....	1	1	Per ct.	1	196	1.99	2.00	4.04	Pounds.	2,960	Pounds.						
				36.6										Days.	2.01	2.05	11,900	
				1										Days.	2.00	2.00	10,200	
														1	Days.	2.08	2.08	11,500
															Days.	1.99	2.03	10,200

C. J. 5.....	1	1	36.6	1	194	1	1	2.02	2.02	2.05	4.14	10,200	2,460
Cathedral.....	1	2	.....	194	.....	.....	.....	2.02	2.02	2.08	4.10	11,200	2,750
	1	2	.....	.....	.....	.....	.....	2.02	2.08	2.07	4.20	10,800	2,570
	1	2	.....	.....	.....	.....	.....	2.06	2.04	2.05	4.18	10,700	2,560
	1	2	.....	.....	.....	.....	.....	2.04	2.08	2.02	4.20	11,700	2,790
Cathedral.....	1	2	.....	194	.....	.....	.....	2.06	2.01	2.08	4.18	4,850	1,040
	1	2	.....	.....	.....	.....	.....	1.90	2.04	2.04	4.16	5,700	1,370
	1	2	.....	.....	.....	.....	.....	2.01	2.09	2.07	4.88	6,900	1,450
	1	2	.....	.....	.....	.....	.....	2.06	2.01	2.07	4.16	5,150	1,240
	1	2	.....	.....	.....	.....	.....	2.01	2.01	2.07	4.16	4,900	1,180
Cathedral.....	1	2	.....	1	198	.....	.....	2.02	2.08	2.05	4.16	6,400	1,540
	1	2	.....	.....	.....	.....	.....	2.02	2.02	2.06	4.16	4,700	1,180
	1	2	.....	.....	.....	.....	.....	2.06	2.02	2.05	4.14	5,600	1,380
	1	2	.....	.....	.....	.....	.....	2.03	2.08	2.09	4.24	5,850	1,870
	1	2	.....	.....	.....	.....	.....	2.02	1.99	2.06	4.10	5,600	1,870
Cathedral.....	1	3	68.3	192	.....	.....	.....	2.04	2.00	2.04	4.08	2,600	637
	1	3	.....	.....	.....	.....	.....	1.97	2.00	2.04	4.08	2,700	662
	1	3	.....	.....	.....	.....	.....	2.01	2.02	2.05	4.08	3,400	837
	1	3	.....	.....	.....	.....	.....	1.99	1.99	2.04	4.08	2,800	664
	1	3	.....	.....	.....	.....	.....	1.97	1.99	2.04	4.06	2,900	727
Cathedral.....	1	3	68.3	1	191	.....	.....	2.05	1.94	2.05	4.00	3,300	825
	1	3	.....	.....	.....	.....	.....	2.02	2.05	2.04	4.13	3,500	827
	1	3	.....	.....	.....	.....	.....	2.00	2.03	2.04	4.14	2,600	667
	1	3	.....	.....	.....	.....	.....	2.07	2.03	2.04	4.14	2,700	652
	1	3	.....	.....	.....	.....	.....	2.05	2.01	2.08	4.08	3,850	944
Silica.....	Neat.	.....	25.8	190	.....	.....	.....	2.08	2.00	2.06	4.12	11,100	2,860
	Neat.	.....	.....	.....	.....	.....	.....	1.98	1.94	2.09	4.05	8,500	2,100
	Neat.	.....	.....	.....	.....	.....	.....	2.03	1.91	2.04	3.90	8,700	2,280
	Neat.	.....	.....	.....	.....	.....	.....	2.02	2.01	2.09	4.20	13,100	3,120
	Neat.	.....	.....	.....	.....	.....	.....	2.00	1.98	2.05	4.06	12,800	3,080
Silica.....	1	1	32.0	180	.....	.....	.....	2.07	2.01	2.08	4.18	16,300	3,900
	1	1	.....	.....	.....	.....	.....	2.00	2.01	2.09	4.20	15,200	3,620
	1	1	.....	.....	.....	.....	.....	2.06	2.04	2.10	4.28	14,600	3,410
	1	1	.....	.....	.....	.....	.....	2.04	2.00	2.07	4.14	15,400	3,720
	1	1	.....	.....	.....	.....	.....	2.07	2.02	2.04	4.12	14,700	3,570
Silica.....	1	1	32.0	180	.....	.....	.....	2.04	2.02	2.07	4.18	7,800	1,870
	1	1	.....	.....	.....	.....	.....	2.00	1.99	2.08	4.14	7,900	1,910
	1	1	.....	.....	.....	.....	.....	1.96	2.02	2.08	4.10	8,800	2,150
	1	1	.....	.....	.....	.....	.....	2.00	2.08	2.07	4.20	9,400	2,240
	1	1	.....	.....	.....	.....	.....	2.02	2.08	2.04	4.14	7,700	1,860
Silica.....	1	1	32.0	1	189	.....	.....	2.02	2.08	2.06	4.18	9,950	2,390
	1	1	.....	.....	.....	.....	.....	1.99	2.00	2.10	4.20	10,500	2,600
	1	1	.....	.....	.....	.....	.....	2.06	2.01	2.06	4.14	10,950	2,640
	1	1	.....	.....	.....	.....	.....	2.02	2.02	2.06	4.16	9,900	2,380
	1	1	.....	.....	.....	.....	.....	2.04	1.99	2.08	4.14	8,900	2,150

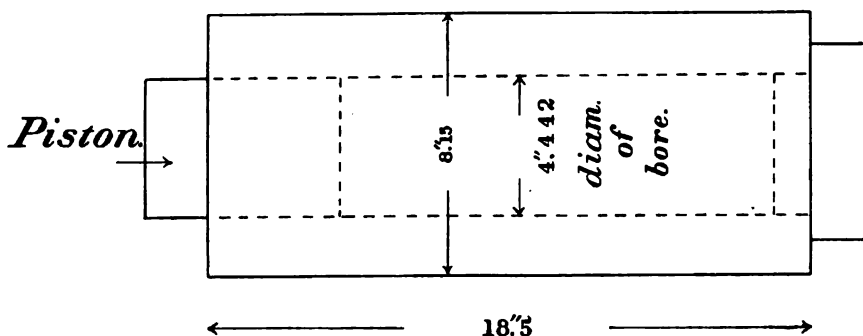
COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, EXCEPTING THE FIRST DAY AFTER MIXING, WHICH WAS IN AIR.—Continued.

Marka.	Brand of cement.	Composition.		Age in—		Dimensions.		Sectional area.	Compressive strength.			Remarks.		
		Cement.	Sand.	Water.	Air.	Water.	Air.		Height.	Compressed surface.	Total.		Per square inch.	Mean.
S. J. 11.	Silica.....	1	2	Per ct. 44.0	Days. 189	Days.	Days.	Inches.	Inches.	Sq. ins.	Pounds.	Pounds.	Pounds.	
								2.01	2.02	4.20	4,400	1,060		
		1	2	44.0	1	188	188	188	2.02	2.00	4.18	4,000	960	940
									2.02	2.07	4.14	4,100	990	
									1.99	2.08	4.16	3,600	865	
									2.04	2.06	4.16	3,500	840	
S. J. 12.	Silica.....	1	3	58.0	Days. 188	Days.	Days.	2.06	1.99	4.26	5,700	1,840	1,800	
								2.06	2.08	4.18	5,300	1,270		
		1	3	58.0	188	188	188	188	2.07	2.06	4.24	5,100	1,200	1,800
									2.06	1.98	4.12	4,800	1,200	
									2.06	2.06	4.12	4,800	1,360	
									2.00	2.06	4.26	6,500	1,560	
S. J. 12.	Silica.....	1	3	58.0	Days. 187	Days.	Days.	2.06	2.06	4.10	1,700	415	829	
								1.98	2.00	4.24	1,500	354		
		1	3	58.0	187	187	187	187	2.02	2.00	4.18	1,450	342	829
									1.98	2.08	4.12	1,100	264	
									1.98	1.99	4.18	1,100	271	
									2.01	2.00	4.24	1,150	271	
S. J. 12.	Silica.....	1	3	58.0	Days. 187	Days.	Days.	2.01	2.00	4.10	8,100	755	626	
								2.02	2.01	4.18	2,100	502		
		1	3	58.0	187	187	187	187	2.02	2.08	4.18	2,500	607	626
									1.98	1.99	4.12	2,500	607	
									1.98	1.99	4.18	3,250	773	
									2.01	2.00	4.10	2,000	488	

NEAT CEMENT AND CEMENT MORTARS SET INITIALLY UNDER HIGH PRESSURES.

This material was put under initial compression immediately after gauging. It was tamped in a cylindrical steel mold having pistons with brass cup-shaped packings at the ends, and loads then applied with the testing machine. One piston was movable, one was fixed. The cement remained under pressure in the mold for a period of twenty-four to sixty-four hours, after which it was forced out and put in water until the time of testing.

SKETCH OF CYLINDRICAL MOLD.



Sectional area of bore, 15.497 square inches.

DETAILS OF MIXING.

June 6, 1903: Alpha cement, neat, gauged with 17 per cent of water by weight, tamped into mold and loaded with 300,000 pounds on piston. After the immediate effect of this load had been received the pressure was reduced to about 220,000 pounds, which remained acting for a period of 41 hours. About 3 ounces of water leaked out during this period. The indurated cement was then forced out of the mold, requiring a maximum force of 65,000 pounds.

Dimensions of the specimen.

Diameter	4.445 inches.
Length	5.567 inches.
Weight, total	8 pounds.
Weight, per cubic foot	160.3 pounds.

June 13, 1903: Cement mortar, 1 : 1 mixture.

Alpha cement	5 pounds.
Sand	5 pounds.
Water, weight	1½ pounds.
Water	25 per cent.

Mixture flushed water when tamped in the mold. Initially loaded with 230,000 pounds. About 3½ ounces of water leaked out. The pressure was reduced to 220,000 pounds, which was sustained for a period of about 24 hours. It required 48,000 pounds to force the specimen from the mold 42 hours after gauging.

Dimensions of the specimen.

Diameter	4.443 inches.
Length	5.873 inches.
Weight, total	8 pounds 2½ ounces.
Weight, per cubic foot	154.8 pounds.

Put in water when removed from mold, where it remained until the time of testing.

July 3, 1903: Cement mortar, 1:2 mixture.

Alpha cement	4 pounds.
Sand	8 pounds.
Water, weight	1½ pounds.
Water	1 per cent.

Loaded with 217,000 pounds, which remained acting for a period of 64 hours. One ounce of water leaked out. Maximum force required to remove specimen from the mold, 68,000 pounds.

Dimensions of the specimen.

Diameter	4.449 pounds.
Length	6.197 pounds.
Weight, total	8 pounds 8¼ ounces.
Weight, per cubic foot	153 pounds.

Fine circumferential cracks were distributed over the surface of the upper half of the specimen. Put into water where it remained until the time of testing.

July 10, 1903: Neat Alpha cement, gauged with 17 per cent of water. Material tamped into steel mold, pistons put in place but no pressure applied. Removed from mold 24 hours later, a maximum force of 18,000 pounds being required.

Dimensions of the specimen.

Diameter	4.441 inches.
Length	6.642 inches.
Weight, total	8 pounds 2½ ounces.
Weight, per cubic foot	137 pounds.

Put into water, where it remained until the time of testing.

July 11, 1903: Neat Alpha cement, gauged with 17 per cent of water. Loaded with 115,000 pounds initial compression for a period of 41 hours. About 1 ounce of water leaked out. Maximum resistance encountered in forcing out of the mold, 29,000 pounds.

Dimensions of the specimen.

Diameter	4.440 inches.
Length	5.681 inches.
Weight, total	8 pounds ¼ ounce.
Weight, per cubic foot	160.7 pounds.

Put into water, where it remained until the time of testing.

July 13, 1903: Neat Alpha cement, gauged with 25 per cent water. Loaded with 217,000 pounds for a period of 40 hours. About 5 ounces of water leaked out. Maximum resistance in forcing out of the mold, 26,000 pounds.

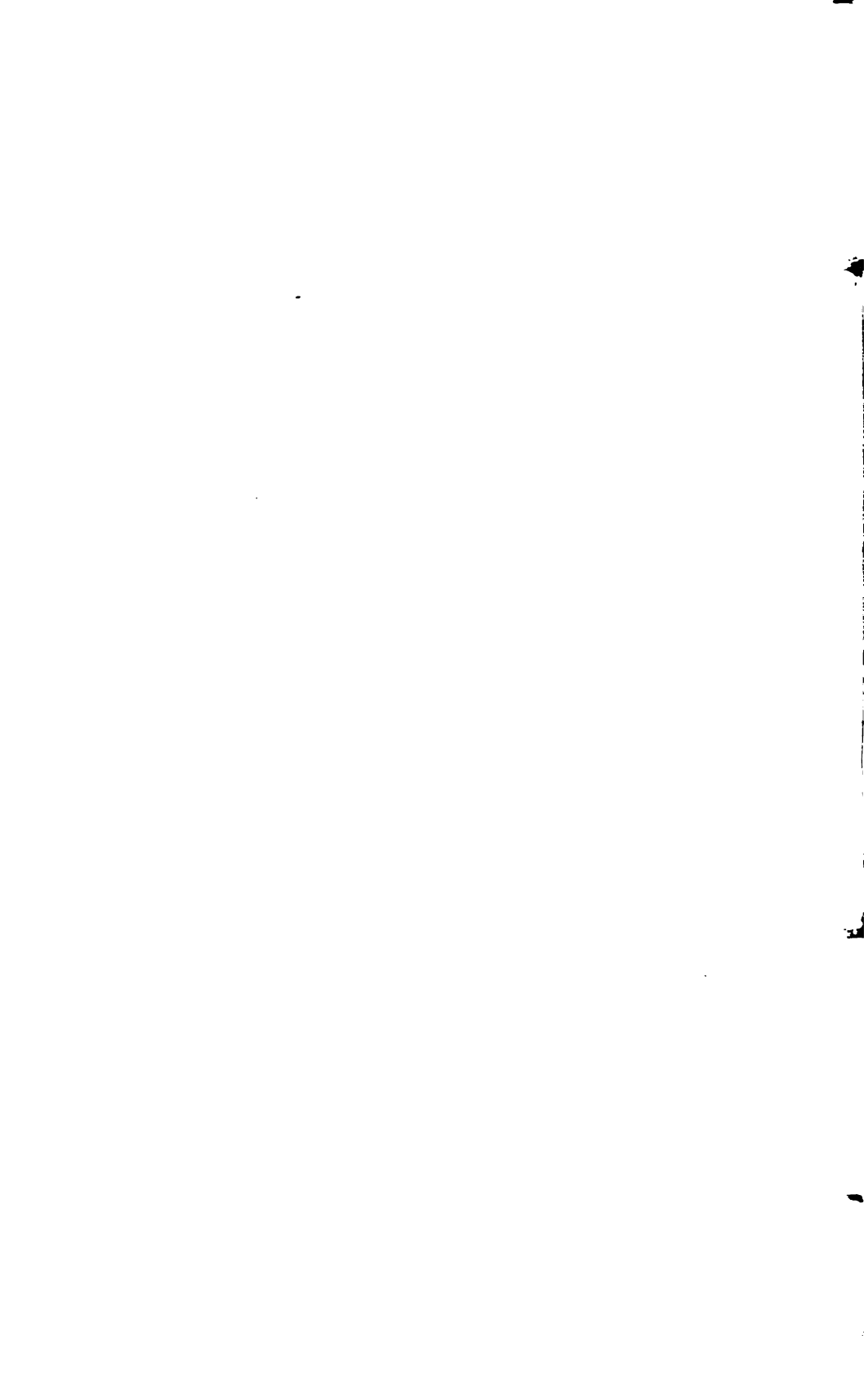
Dimensions of the specimen.

Diameter	4.441 inches.
Length	5.804 inches.
Weight, total	7 pounds 6¼ ounces.
Weight, per cubic foot	148.3 pounds.

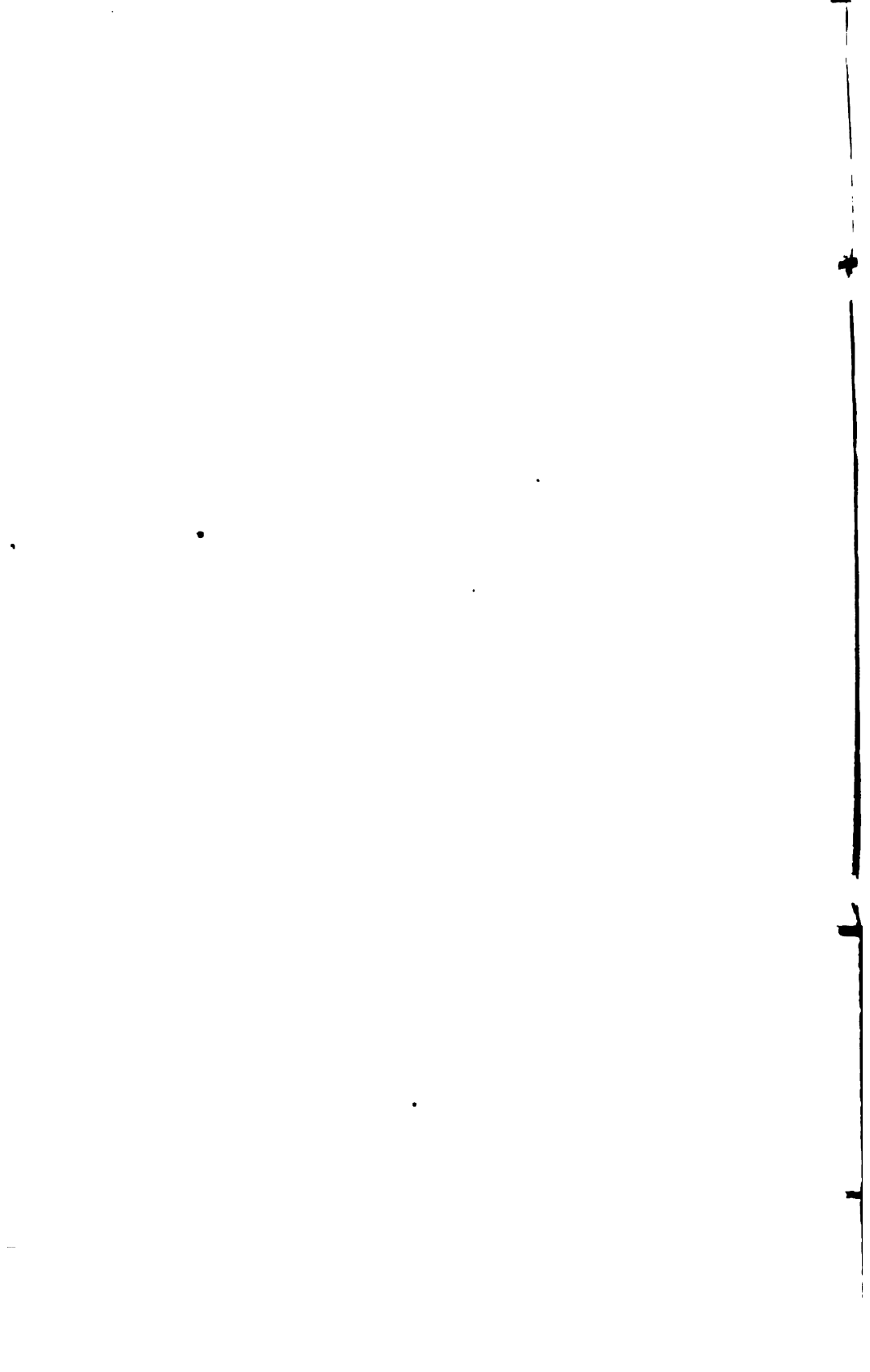
Put into water, where it remained until the time of testing.

COMPRESSION TESTS OF NEAT CEMENTS AND CEMENT MORTARS SET INITIALLY UNDER HIGH PRESSURES.

Date of gauging.	Composition as gauged.			Initial pressures.		Age when tested.	Weight per cubic foot.	Dimensions.		Sectional area.	First crack.	Compressive strength.	
	Cement.	Sand.	Water.	Total.	Per square inch.			Length.	Diameter.			Total.	Per square inch.
1903.													
June 6	Neat		Per cent. 17	Pounds. 300,000	Pounds. 19,360	80	Pounds. 160.3	Inches. 5.587	Inches. 4.445	Sq. inches. 15.52	Pounds. 259,000	Pounds. 296,800	19,120
June 13	1		26	220,000	14,200	30	164.8	6.873	4.449	15.50	217,200	217,200	14,010
July 3	1	2	28.1	280,000	14,840	67	158.0	6.197	4.449	15.57	182,900	182,900	8,585
July 10	Neat		17	217,000	14,000	56	137.0	6.642	4.441	15.52	117,200	117,200	7,550
July 11	Neat		17	116,000	7,420	59	160.7	5.681	4.440	15.49	288,000	280,400	18,102
July 18	Neat		25	217,000	14,000	57	148.3	5.804	4.441	15.49	327,000	341,600	22,063



**CEMENT SLEEVES ON STEEL CORES STRAINED
IN TENSION.**



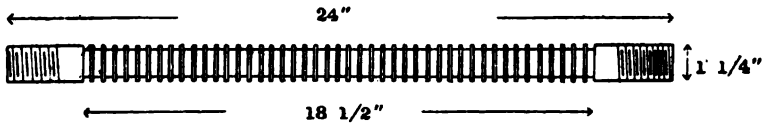
CEMENT SLEEVES ON STEEL CORES STRAINED IN TENSION.

Sleeves of neat Portland cement and cement mortar were molded over grooved steel cores and strained by loads of tension. Preliminary observations were made on the extension of the naked cores, after which they were incased in the sleeves and again tested. The stresses were applied to the projecting ends of the cores, measuring the extension on the cement sleeve on a gauged length covering the middle part of its length.

During the setting of the cement, cracks were formed circumferential and radial. While under test these initial cracks opened wider as loads of tension were applied, and new circumferential cracks were formed. The details of the tests state under what loads and extensions of the sleeves additional cracks appeared. Some cracks which were visible when the loads were acting closed upon release of stress.

No. 10591.

OBSERVATIONS WITH GROOVED STEEL BARS PRIOR TO EXPERIMENTS ON TENSILE STRAINS OF CEMENTS.



Bars grooved over 18" .5 of their length.

Diameter at bottom of grooves.....	inch.....	1.
Sectional area at bottom of grooves.....	square inch.....	.7854
Width of grooves.....	inch.....	.25
Width of lands.....	do.....	.125
Gauged length.....	inches.....	15.

Applied loads.		Number of bar.			Remarks.
Total.	Per square inch.	1.	2.	3.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	1,270	0.	0.	0.	
10,000	12,730	.0044	.0082	.0059	
20,000	25,460	.0108	.0125	.0123	
30,000	38,200	.0171	.0185	.0185	
40,000	50,930	.0235	.0251	.0247	
50,000	63,660	.0298	.0313	.0311	
55,000	70,090	.0328	.0363	.0344	
1,000	1,270	-.0006	+.0022	.0004	
10,000	12,730	.0046	.0083	.0064	
20,000	25,460	.0110	.0148	.0128	
30,000	38,200	.0173	.0211	.0189	
40,000	50,930	.0237	.0274	.0250	
50,000	63,660	.0300	.0338	.0311	
55,000	70,090	.0327	.0366	.0342	
1,000	1,270	-.0006	.0028	.0005	

The above bars were incased in sleeves of neat Alpha cement gauged with 25 per cent of water, and set in air.

Number of bar.	Cement sleeve.		Thickness of sleeve.
	Diameter.	Length.	
1.....	<i>Inches.</i> 1.75	<i>Inches.</i> 18	<i>Inch.</i> 0.25
2.....	2.25	18	.60
3.....	3.25	18	1.00

TENSILE TESTS OF SLEEVES OF NEAT CEMENT ON GROOVED STEEL BARS.

No. 10610.

Bar No 1.

Neat Alpha cement sleeve, exterior diameter, 1".73.

Set in air 31 days.

Gauged length, on cement sleeve, 15".

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0059	0.	
20,000	.0125	0.	
30,000	.0188	0.	Minute cracks in the cement.
40,000	.0255	0.	Numerous cracks opened in the cement.
50,000	.0825	0.	
55,000	.0850	.0002	

Cracks developed along the cement sleeve at intervals of $1\frac{1}{4}$ " to 4". While the bar was under stresses above 40,000 pounds they were visible to the eye. One of the principal cracks after loading with 55,000 pounds could be discerned upon release of the load to 11,000 pounds tension, but below this load it closed and was not visible with a hand magnifying glass.

55,000 pounds was applied and released ten times. Cracks opened and were easily seen as above described, while the bar was under load and closed again when the load was released.

No. 10611.

Bar No. 2.

Neat Alpha cement sleeve, exterior diameter, 2".22.

Set in air, 32 days.

Gauged length, on cement sleeve, 15".

There were a number of shrinkage cracks in the cement sleeve before commencing the test.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0063	0.	Original cracks perceptibly widen under load, and new one found.
20,000	.0130	.0003	
30,000	.0195	.0002	
40,000	.0262	0.	
50,000	.0830	.0002	
55,000	.0875	.0009	

New cracks began to appear when the load on the bar reached 10,000 pounds and additional ones appeared at intervals as higher loads were applied. The principal cracks increased in the width of openings also as higher loads of tension were reached. Upon release of tension the cracks diminished in width and some were closed and lost to sight.





NO. 10, 612.

PHOTOGRAPH SHOWING CRACKS IN CEMENT SLEEVE, WHEN THE STEEL CORE
WAS UNDER LOAD OF 50,000 LBS. TENSION. MAGNIFICATION $2\frac{1}{2}$ DIAMS.

HELIOTYPE CO., BOSTON.



NO. 10, 612.

PHOTOGRAPH SHOWING CRACKS IN CEMENT SLEEVE, AFTER A LOAD OF 50,000 LBS. HAD BEEN APPLIED TO THE STEEL CORE AND RELEASED. MAGNIFICATION $2\frac{1}{2}$ DIAMS.

HELIOTYPE CO., BOSTON.

No. 10612.

Bar No. 3.

Neat Alpha cement sleeve, exterior diameter, 3".22.

Set in air 32 days.

Gauged length, on cement sleeve, 15".

There were a number of shrinkage cracks in the cement sleeve before commencing the test.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0081	.0003	Snapping sound.
20,000	.0113	.0006	Original cracks perceptibly widen and new ones appear under 18,000 pounds tension.
30,000	.0170	.0007	
40,000	.0232	.0006	
50,000	.0305	.0007	
55,000	.0340	.0009	

New cracks increased in number after 18,000 pounds tension on the bar, and the initial cracks increased in extent. The cracks expanded and contracted in width alternately as loads were applied and released.

No. 10628.

Marks, Atlas, April 3, 1903.

Neat Atlas cement sleeve on grooved steel bar of 1.09 carbon.

Exterior diameter of sleeve, 1".74.

Set in air 38 days.

Gauged length, on cement sleeve, 15".

There were numerous initial cracks on the exterior surface of the sleeve before testing. The sleeve shrunk away from the steel core at the ends and developed both radial and circumferential cracks. The latter were the more numerous, along one element there being twelve such initial cracks, fine lines ".002± in width.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0057	0.	
20,000	.0121	-.0002	Two additional cracks appear.
30,000	.0182	-.0003	
40,000	.0245	-.0003	
50,000	.0307	-.0003	A third fresh crack in sight.
55,000	.0342	-.0003	

The primitive cracks opened perceptibly while the bar was loaded and closed partially when the load was released.

No. 10629.

Marks, Atlas, April 3, 1903.

Neat Atlas cement sleeve, exterior diameter, 2".23.

Set in air, 38 days.

Gauged length, on cement sleeve, 15".

Twelve circumferential cracks existed along the sleeve, on one side, before the test.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0066	.0002	Two new cracks appear.
20,000	.0134	.0001	A third new crack appears.
30,000	.0200	0.	Two more cracks appear.
40,000	.0265	0.	One more crack appears.
50,000	.0330	-.0001	
55,000	.0358	0.	Two more cracks appear.

No. 10630.

Marks, Atlas, April 3, 1903.

Neat Atlas cement sleeve, exterior diameter 3".23.

Set in air 38 days.

Gauged length, on cement sleeve, 15".

There were seven circumferential cracks existing in the cement sleeve on one side before testing, also one pronounced radial crack at each end.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0068	-.0007	
20,000	.0141	-.0008	One new crack.
30,000	.0206	-.0012	A second new crack.
40,000	.0276	-.0011	
50,000	.0346	-.0010	
55,000	.0381	-.0011	No additional cracks.

No. 10631.

Marks, Alpha 1, sand 1, April 4, 1903.

Cement mortar sleeve, exterior diameter 2".22.

Set in air 38 days.

Gauged length, on cement sleeve, 15".

One circumferential crack in the cement sleeve, on one side, before testing.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0064	0.	Four new cracks appear.
20,000	.0117	-.0002	One more crack in sight.
30,000	.0179	-.0002	Sixth crack in sight.
40,000	.0241	-.0001	Seventh crack in sight.
50,000	.0306	0.	Eighth crack in sight.
55,000	.0337	0.	Ninth crack in sight.

No. 10632.

Marks, Alpha 1, sand 1, April 4, 1903.

Cement mortar sleeve, exterior diameter, 3".22.

Set in air 38 days.

Gauged length, on cement sleeve, 15".

Three circumferential cracks in sight before testing.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0060	0.	
20,000	.0135	-.0002	Two new cracks appear.
30,000	.0208	-.0001	Two more cracks appear.
40,000	.0273	-.0001	One more crack appears.
50,000	.0344	-.0002	Do.
55,000	.0380	-.0005	No more cracks in sight.

No. 10632a.

Marks, Alpha 1, sand 1, April 4, 1903.

Returned to the testing machine and reloaded.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0067	.....
20,000	.0137	.....
30,000	.0205	.....
40,000	.0256	.....
50,000	.0347	.....
55,000	.0381	.0008	

No. 10633.

Marks, Alpha 1, sand 2, April 6, 1903.

Cement mortar sleeve, exterior diameter, 2".26.

Set in air 36 days.

Gauged length, on cement sleeve, 15".

No cracks were visible in cement sleeve, before testing.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0055	.....	Two cracks appear.
20,000	.0119	.....	Three more cracks appear.
30,000	.0181	.....	Do.
40,000	.0244	.....	Two more cracks appear.
50,000	.0291	.....	No more cracks in sight.
55,000	.0326	.0006	

No. 10634.

Marks, Alpha 1, sand 2, April 6, 1903.

Cement mortar sleeve, exterior diameter, 3".22.

Set in air 37 days.

Gauged length, on cement sleeve, 15".

No cracks were visible in cement sleeve before testing.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0064	0.	One crack opened.
20,000	.0134	.0001	Three more cracks appear.
30,000	.0206	.0004	Two more cracks appear.
40,000	.0282	.0008	One more crack appears.
50,000	.0368	.0015	
55,000	.0444	.0046	No more cracks in sight.

No. 10635.

Marks, Alpha 1, sand 3, April 7, 1903.

Cement mortar sleeve, exterior diameter, 2".25.

Set in air 36 days.

Gauged length, on cement sleeve, 15".

No cracks were visible in cement sleeve before testing.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0060	-.0001	
20,000	.0120	-.0003	
30,000	.0181	-.0004	
40,000	.0246	-.0006	One crack develops.
50,000	.0309	-.0006	Two more cracks appear.
55,000	.0357	+.0012	Do.

No. 10636.

Marks, Alpha 1, sand 3, April 7, 1903.

Cement mortar sleeve, exterior diameter, 3".23.

Set in air 36 days.

Gauged length, on cement sleeve, 15".

No cracks were visible in cement sleeve before testing.

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0050	-.0005	One crack develops.
20,000	.0109	-.0005	One more crack appears.
30,000	.0169	-.0006	
40,000	.0280	-.0006	Do.
50,000	.0295	-.0004	Two more cracks appear.
55,000	.0329	-.0003	One more crack appears.
50,000	.0300	-.0002	
50,000	.0299	-.0002	

No. 10637.

Marks, Alpha 1, sand 3, April 8, 1903.

Cement mortar sleeve, exterior diameter, 3".24.

Core, .09 carbon steel.

Set in air 35 days.

Gauged length, on cement sleeve, 15".

Total applied loads.	Elongation.	Set.	Remarks.
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
10,000	.0060	-.0002	
20,000	.0124	-.0001	
25,000	.0157		
30,000	.0191	0.	One crack develops.
35,000	.0225		One more crack appears.
36,000			Elastic limit of steel bar.
35,600	.0185	.0266	Two wide cracks appear.
35,000	.0897		
36,000	.3660		

Eleven very pronounced cracks opened in the cement sleeve.

DETERMINATION OF WATER AND CARBON DIOXIDE IN HYDRATED CEMENTS.

The amount of water retained in a number of samples of hydrated cements after exposure to different temperatures was determined as follows:

Two-inch cubes were broken up; the central parts of each were ground to a powder and used in the determinations. The finely ground hydrated cement was initially dried at 110° C. While hot the powder was divided into a number of portions, and each portion put into a separate dry vial. About 1 gramme from each bottle in succession

was taken, placed in a platinum boat, and heated in an electrical furnace to a constant weight for the several temperatures recorded, and the loss in weight noted.

The material was then put into a combustion apparatus and heated to redness. The volatile matter was drawn by suction through a train of tubes, the CO_2 evolved being determined by absorption in KOH . After cooling, the boat and contents were again weighed and the total loss ascertained. The amount of water was taken by difference between the total loss and the CO_2 evolved. The loss in heating at the several temperatures between 110°C . and redness was taken as water when the CO_2 evolved during the subsequent heating to redness was found to be normal, and, when not, the difference in CO_2 of the sample and the normal quantity in the material was deducted.

The cubes used were one year or more old. The brands, water used in gauging, and conditions of setting were as follows:

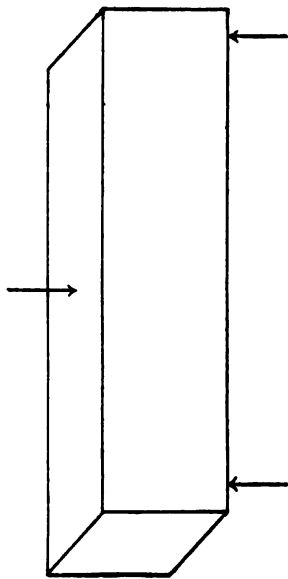
Brand.	Marks.	Water used in gauging.	Cubes set in—
		<i>Per cent.</i>	
Lehigh	L J14	27.0	Water.
Obelisk	O J27	40.5	Air.
Newark and Rosendale	N&R J26	37.6	Air.
Silica	S J19	25.8	Air.

TABLE SHOWING THE TOTAL LOSS IN WATER AND CARBON DIOXIDE WHEN HEATING GROUND HYDRATED CEMENTS TO DIFFERENT TEMPERATURES FROM A TEMPERATURE OF 110°C .

Brand.	Temperature, centigrade.	Loss in—	
		H_2O .	CO_2 .
Lehigh	200	<i>Per cent.</i> 5.16	<i>Per cent.</i>
	300	7.04	.....
	400	8.50	.....
	500	10.61	.....
	600	11.00	3.44
	Redness.	11.40	3.56
Obelisk	200	3.70	.....
	300	7.91	.....
	400	9.50	.....
	500	9.80	1.00
	600	12.95	4.38
	Redness.	13.00	4.40
Newark and Rosendale	200	3.73	.....
	300	6.79	.....
	400	8.40	2.88
	500	9.80	4.58
	600	9.76	9.54
	Redness.	9.78	9.54
Silica	200	3.10	.....
	300	4.45	.....
	400	5.66	.....
	500	6.23	.....
	600	8.00	.....
	Redness.	8.09	21.74

Remarks.—Silica cement was made of Portland cement, 40 per cent; crushed limestone, 60 per cent.

TRANSVERSE TESTS OF CEMENTS.



Prisms supported at the ends 21 1/4' apart, loaded at the middle.

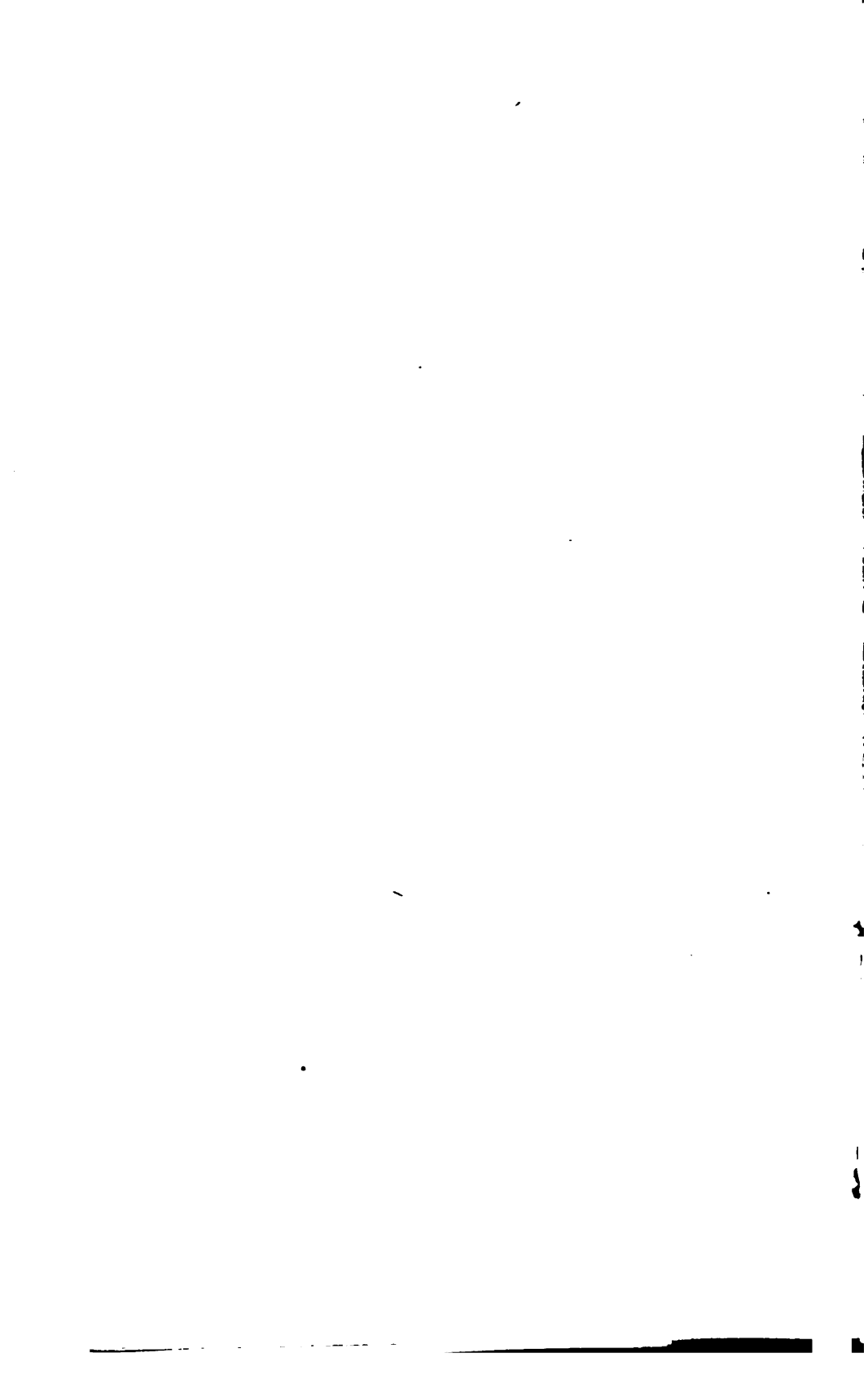
Brand of cement.	Composition.		Age.	Weight.		Dimensions.			Ultimate strength.		Remarks.			
	Cement.	Sand.		Water.	Set in—	Total.	Per cubic foot.	Length.	Breadth.	Depth.		Total.	Modulus of rupture per square inch.	
Peninsular	Neat	Percent. 21.7	Air ...	Mos. 8	days 9	Pounds. 44	Pounds. 153.3	Inches. 23.92	Inches. 3.96	Inches. 6.02	Pounds. 1,220	Pounds. 274	

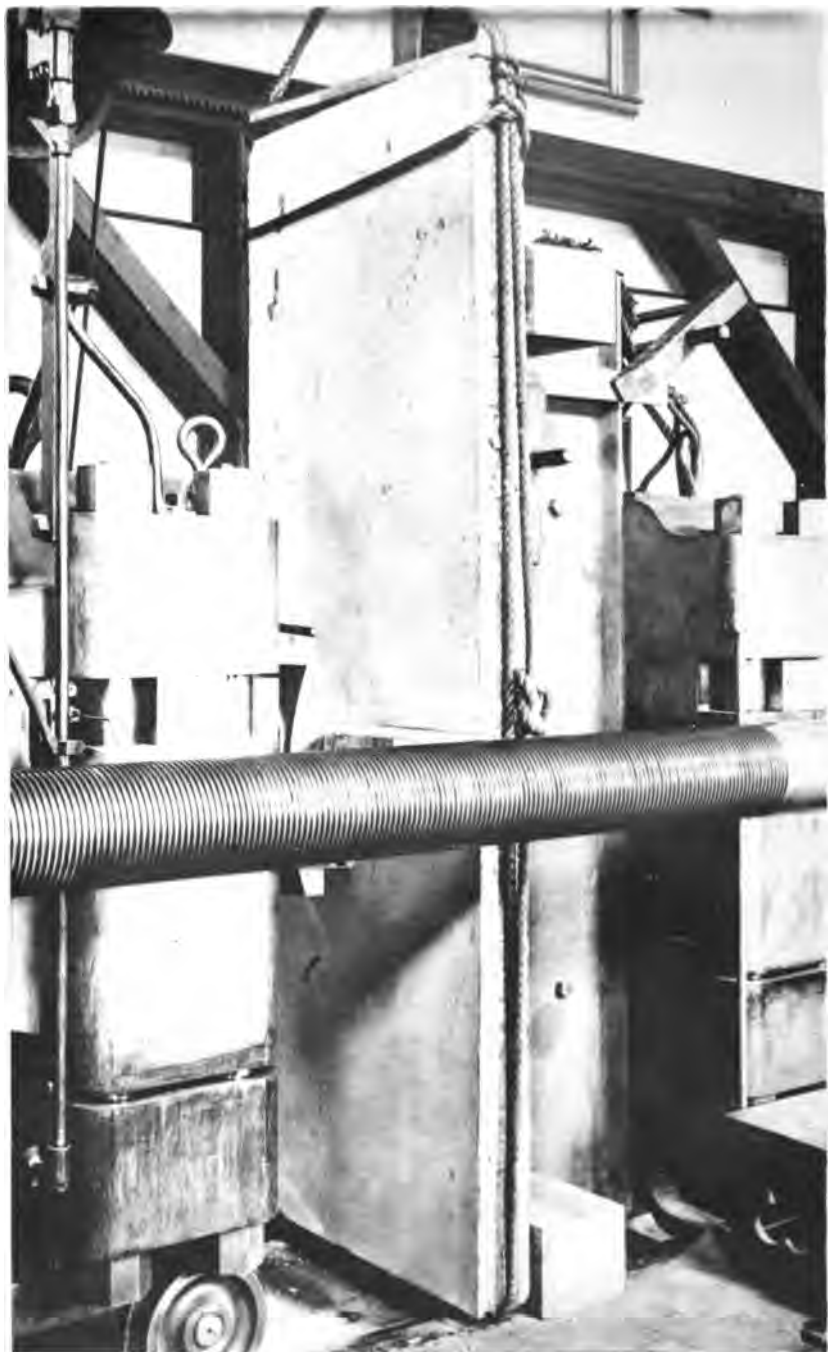
Prisms supported at the ends 21½" apart, loaded at the middle.

Brand of cement.	Composition.		Set in—	Age.	Weight.		Dimensions.			Ultimate strength.		Remarks.
	Cement.	Sand.			Water.	Total.	Percubic foot.	Length.	Breadth.	Depth.	Total.		Modulus of rupture per square inch.
Whitehall.....	Neat.....		Percent.	Mos. days.	Pounds.	Pounds.	Inches.	Inches.	Inches.	Pounds.	Pounds.	
Do.	Neat.....		20.6	0	43½	131.1	24.06	3.32	6.07	2,594	579	
Do.	Neat.....		20.8	16	46	132.6	24.10	4.06	6.09	2,018	430	
Do.	Neat.....		21.3	5	42½	131.9	24.02	3.36	6.06	1,660	360	

COMPOSITE CONCRETE FLOORING.

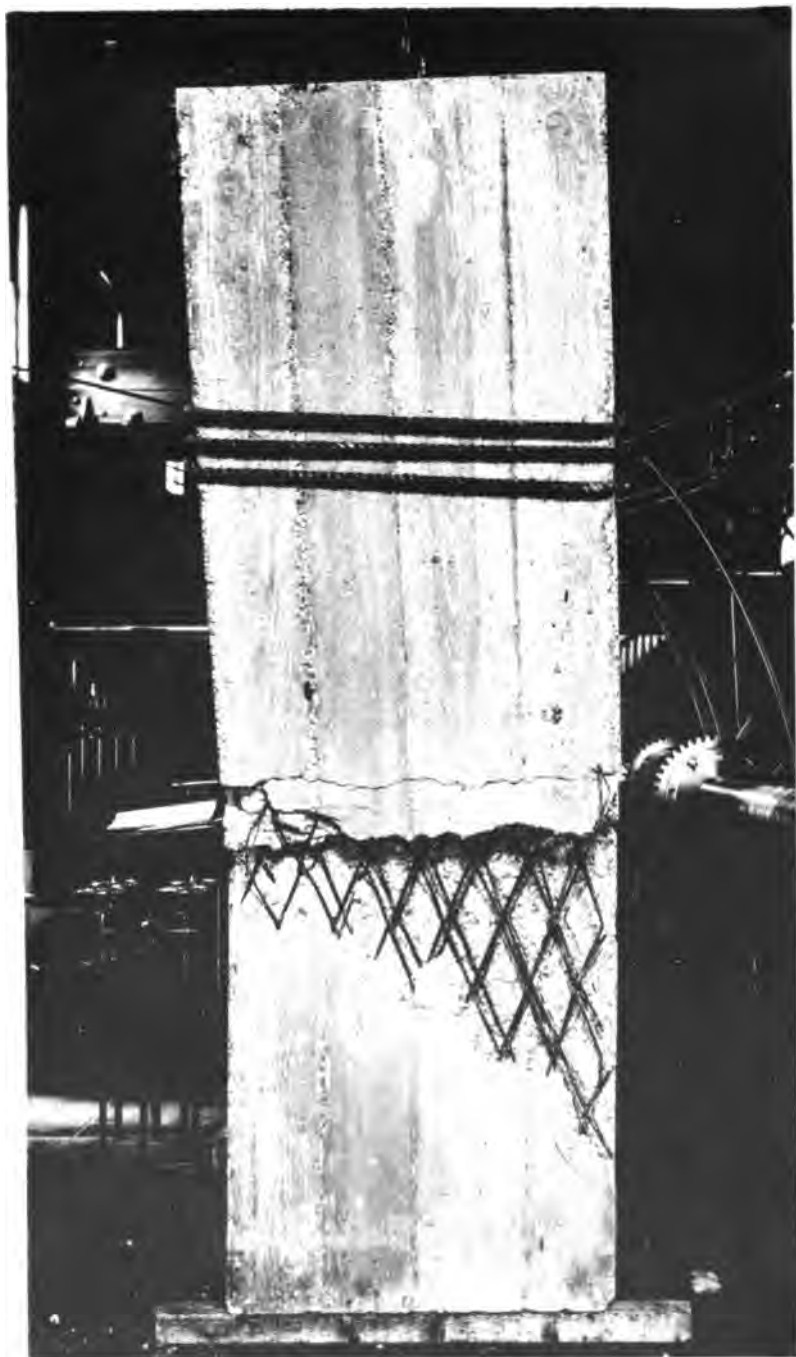
This material represents the construction of the flooring of room for the storage of photographic plates at the Astronomical Observatory, Harvard University.





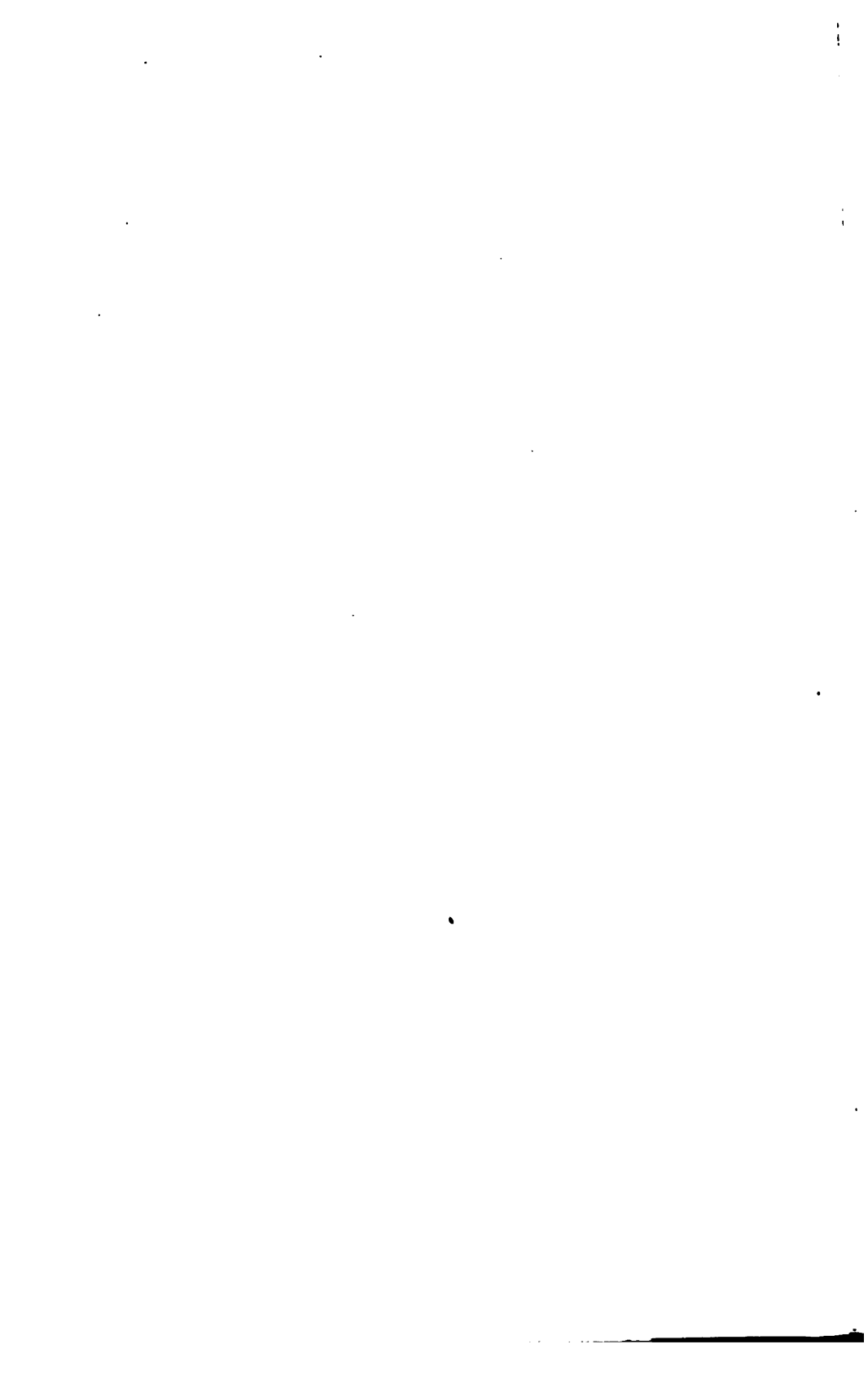
PHOTOGRAPH SHOWING COMPOSITE CONCRETE SLAB BEFORE TESTING.





PHOTOGRAPH SHOWING UNDER SIDE OF COMPOSITE CONCRETE SLAB AFTER TESTING.

HELIOTYPE CO., BOSTON.



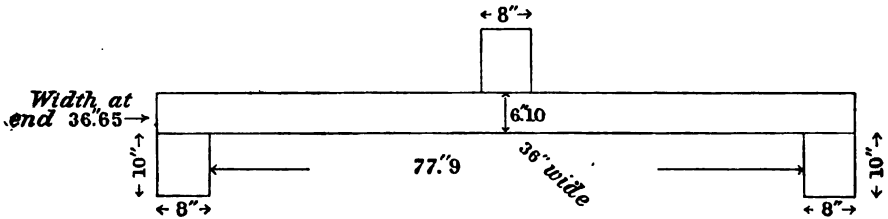
COMPOSITE CONCRETE FLOORING FURNISHED BY THE EASTERN EXPANDED METAL COMPANY, BOSTON, MASS.

TRANSVERSE TEST.

Composition: Alpha Portland cement, 1; coarse bank sand, 2½; crushed stone, 5.

Age, about 50 days.

Metal binder used, of two-ply, 6-inch mesh, expanded metal cut from No. 4 gauge Bessemer steel plate, about 1" and 1½" from the bottom surface of slab. The inside dimensions of the 6-inch mesh No. 4 expanded metal when placed in the slab were 5" minor diameter and 11" major diameter of mesh.



Deflections measured on a chord of 73."5, taken on bottom side of flooring.

Applied loads.		Deflec- tions.	Remarks.
Total.	Fiber stress.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	Initial load. Cracks developed on tension side. Ultimate strength.
1, 146	100	0.	
2, 292	200	.009	
3, 438	300	.020	
4, 584	400	.051	
5, 730	500	.080	
6, 876	600	.115	
8, 022	700	.150	
9, 168	800	.186	
10, 314	900	.220	
11, 460	1, 000	.263	
.....	100	.09	
12, 606	1, 100	.356	
13, 752	1, 200	.788	

Deflections continued while the load sustained gradually dropped. Loads were continued until the flooring was deflected about 10" at the middle. The metal forming the meshes fractured in ten places at the angles of the meshes.

CINDER-CONCRETE CUBES.

COMPRESSION TESTS.

Specimens furnished by the Eastern Expanded Metal Company, of Boston, Mass.
Lehigh Portland cement used.
Cubes set in air.

[Proportions of ingredients stated by volume.]

No. of test.	Marks.	Composition.			Age. Days.	Weight.		Dimensions.		Sectional area. Sq. inches.	First crack. Pounds.	Compressive strength.	
		Cement.	Sand.	Cinders.		Water.	Total.	Per cubic foot.	Height.			Compressed surface.	Total.	Per square inch.
1514	1	1	2	4	1	Pounds. 1154	Inches. 12.16	Inches. 12.11	Inches. 12.16	Pounds. 287,000	Pounds. 287,000	Pounds. 1,960	
1516	2	1	2	4	1	115	12.11	12.09	12.16	301,200	301,200	1,400	
1516	3	1	2	4	1	114	12.15	12.05	11.86	847,000	847,000	2,050	
1517	4	1	2	4	1	115	12.09	12.08	12.22	869,000	869,000	2,600	
1518	5	1	2	4	1	112	12.00	12.09	12.00	862,700	862,700	2,600	
1523	1	1	2	5	1	112	12.00	12.11	12.21	207,004	207,004	1,400	
1524	2	1	2	5	1	113	12.27	12.06	11.98	202,500	202,500	1,400	
1525	3	1	2	5	1	111	11.95	12.19	12.06	231,000	231,000	1,570	
1526	4	1	2	5	1	110	11.90	12.04	12.17	230,200	230,200	1,960	
1527	5	1	2	5	1	112	12.00	12.09	12.21	238,600	238,600	2,020	
1532	1	1	3	6	2	107	12.05	12.06	12.08	174,086	174,086	1,200	
1533	2	1	3	6	2	106	12.00	11.94	12.03	191,000	191,000	1,350	
1534	3	1	3	6	2	107	12.12	12.19	11.98	196,000	196,000	1,350	
1535	4	1	3	6	2	108	12.05	12.05	12.05	246,840	246,840	1,730	
1536	5	1	3	6	2	105	12.01	12.01	12.10	217,800	217,800	1,560	

CINDER-CONCRETE CUBES.

COMPRESSIVE ELASTIC PROPERTIES.

No. 1514.

Composition: Lehigh Portland cement, 1; sand, 2; cinder water, $1\frac{1}{2}$.

Marks, 1.

Age, set in air, 38 days.

Weight, $115\frac{1}{2}$ pounds = 111.5 pounds per cubic foot.

Dimensions: $12'' \cdot 16 \times 12'' \cdot 11 \times 12'' \cdot 16$.

Sectional area, 147.26 square inches.

Gauged length, 5''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14, 726	100	0.	0.	Initial load.
29, 452	200	.0001	0.	
44, 178	300	.0008	0.	
58, 904	400	.0005	0.	
73, 630	500	.0007	0.	
88, 356	600	.0010	0.	
103, 082	700	.0013	.0001	
117, 808	800	.0016	.0001	
132, 534	900	.0020	.0002	
147, 260	1, 000	.0024	.0003		E (500-1,000) = 1,786,000 pounds per square inch
161, 986	1, 100	.0028	.0004	
176, 712	1, 200	.0034	.0005	
191, 438	1, 300	.0040	.0007	
206, 164	1, 400	.0047	.0009	
220, 890	1, 500	.0055	.0012	E (1,000-1,500) = 1,136,000 pounds per square inch
235, 616	1, 600	.0065	.0016	
250, 342	1, 700	.0080	.0023	
265, 068	1, 800	.0099	.0033	
279, 794	1, 900	.0128	.0050		Ultimate strength.
287, 000	1, 960			

No. 1515.

Composition: Lehigh Portland cement, 1; sand, 2; cinders, 4; water, $1\frac{1}{4}$.

Marks, 2.

Age, set in air, 38 days.

Weight, 115 pounds = 111.7 pounds per cubic foot.

Dimensions: $12'' \cdot 11 \times 12'' \cdot 09 \times 12'' \cdot 16$.

Sectional area, 147.01 square inches.

Gauged length, 5''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,701	100	0.	0.	Initial load.
29,402	200	.0002	0.	
44,104	300	.0004	0.	
58,804	400	.0006	0.	
73,505	500	.0009	0.	
88,206	600	.0012	.0001	
102,907	700	.0015	.0001	
117,606	800	.0018	.0002	
132,309	900	.0022	.0002	
147,010	1,000	.0026	.0004		E (500-1,000) = 1,923,000 pounds per square inch.
161,711	1,100	.0031	.0005	
176,412	1,200	.0037	.0006	
191,113	1,300	.0043	.0008	
205,814	1,400	.0050	.0010	
220,515	1,500	.0058	.0014	E (1,000-1,500) = 1,136,000 pounds per square inch.
235,216	1,600	.0067	.0016	
249,917	1,700	.0078	.0020	
264,618	1,800	.0092	.0029	
279,319	1,900	.0112	.0039	
301,200	2,050	.....	.....	Ultimate strength.

No. 1517.

Composition: Lehigh Portland cement, 1; sand, 2; cinders, 4; water, $1\frac{1}{4}$.

Marks, 4.

Age, set in air 224 days.

Weight, 115 pounds = 111.3 pounds per cubic foot.

Dimensions: $12'' \times 12'' \times 12'' \times 12'' \times 22''$.

Sectional area, 147.62 square inches.

Gauged length, 5''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,762	100	0.	0.	Initial load.
29,524	200	0.	0.	
44,286	300	.0004	.....
59,048	400	.0007	.....
73,810	500	.0010	0.	
88,572	600	.0014	.....
103,334	700	.0017	.....
118,096	800	.0022	.....
132,858	900	.0026	.....
147,620	1,000	.0031	.0004		E (500-1,000) = 1,471,000 pounds per square inch.
162,382	1,100	.0036	E (1,000-1,500) = 1,136,000 pounds per square inch.
177,144	1,200	.0041	.....
191,906	1,300	.0046	.....
206,668	1,400	.0053	.....
221,430	1,500	.0059	.0010	
236,192	1,600	.0065	.....
250,954	1,700	.0072	.....
265,716	1,800	.0079	.....
280,478	1,900	.0088	.....
295,240	2,000	.0096	.0024		E (1,500-2,000) = 1,087,000 pounds per square inch.
310,002	2,100	.0109	First crack. Ultimate strength.
324,764	2,200	.0123	.....
339,526	2,300	.0132	.....
354,288	2,400	.0146	.....
369,000	2,500	.....	.....
384,000	2,600	.....	.....
		
		

No. 1518.

Composition: Lehigh Portland cement, 1; sand, 2; cinders, 4; water, $1\frac{1}{2}$.

Marks, 5.

Age, set in air, 224 days.

Weight, $112\frac{1}{2}$ pounds = 111.6 pounds per cubic foot.

Dimensions: $12'' \times 12'' \times 12''$.

Sectional area, 145.08 square inches.

Gauged length, 5''.

Applied loads.		In gauged length.		Remarks.	
Total.	Per square inch.	Compression.	Set.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.	
14,508	100	0.	0.		
29,016	200	0.	E (500-1,000) = 1,563,000 pounds per square inch.	
43,524	300	0.	.....	
58,032	400	.0002	.....	
72,540	500	.0005	0.		
87,048	600	.0008	.....	
101,556	700	.0011	.....	
116,064	800	.0015	.....	
130,572	900	.0019	.....	
145,080	1,000	.0024	.0003		
159,588	1,100	.0029	.....	
174,096	1,200	.0033	E (1,000-1,500) = 1,316,000 pounds per square inch.	
188,604	1,300	.0039	.....	
203,112	1,400	.0044	.....	
217,620	1,500	.0050	.0010		
232,128	1,600	.0060	.....	
246,636	1,700	.0066	.....	
261,144	1,800	.0073	.....	
275,652	1,900	.0081	.....	
290,160	2,000	.0091	.0025		
304,668	2,100	.0108	.....	
319,176	2,200	.0121	E (1,500-2,000) = 962,000 pounds per square inch.	
333,684	2,300	.0135	.....	
348,192	2,400	.0154	.....	
362,700	2,500	.0189	.0069		
					E (2,000-2,500) = 463,000 pounds per square inch. Snapping sounds; first crack and ultimate strength.

Failed on application of 360,000 pounds total compression after release to initial load following the load of 2,500 pounds per square inch.

No. 1523.

Composition: Lehigh Portland cement, 1; sand, 2½; cinders, 5; water, 1¾.

Marks, 1.

Age, set in air, 38 days.

Weight, 112 pounds=109.1 pounds per cubic foot.

Dimensions: 12"×12".11×12".21.

Sectional area, 147.86 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14, 786	100	0.	0.	Initial load.
29, 572	200	.0001	0.	
44, 358	300	.0004	0.	
59, 144	400	.0008	0.	
73, 930	500	.0011	.0001	
88, 716	600	.0015	.0002	
108, 502	700	.0019	.0008	
118, 288	800	.0025	.0004	
133, 074	900	.0032	.0006	
147, 860	1, 000	.0039	.0009	E (500-1,000)=1,260,000 pounds per square inch.
162, 646	1, 100	.0060	.0018	
177, 482	1, 200	.0065	.0021	
192, 218	1, 300	.0091	.0036	
207, 004	1, 400	.....	.....	Ultimate strength.

No. 1524.

Composition: Lehigh Portland cement, 1; sand, 2½; cinders, 5; water, 1¾.

Marks, 2.

Age, set in air, 38 days.

Weight, 113½ pounds=110.6 pounds per cubic foot.

Dimensions: 12".27×12".06×11".98.

Sectional area, 144.48 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14, 448	100	0.	0.	Initial load.
28, 896	200	.0003	0.	
43, 344	300	.0007	.0001	
57, 792	400	.0012	.0008	
72, 240	500	.0017	.0005	
86, 688	600	.0024	.0007	
101, 136	700	.0031	.0010	
115, 584	800	.0042	.0014	
130, 032	900	.0053	.0020	
144, 480	1, 000	.0069	.0029	E (500-1,000)=898,000 pounds per square inch.
158, 928	1, 100	.0087	.0040	
173, 376	1, 200	.0111	.0065	
187, 824	1, 300	.0145	.0078	
202, 500	1, 400	.....	.....	Ultimate strength.

No. 1526.

Composition: Lehigh Portland cement, 1; sand, $2\frac{1}{2}$; cinders, 5; water, $1\frac{3}{4}$.

Marks, 4.

Age, set in air, 224 days.

Weight, $110\frac{1}{2}$ pounds = 109.5 pounds per cubic foot.

Dimensions: $11'' \times 12'' \times 12''$.

Sectional area, 146.53 square inches.

Gauged length, 5''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,658	100	0.	0.	Initial load.
29,306	200	.0003	.....
43,959	300	.0006	.....
58,612	400	.0011	.....
73,265	500	.0015	.0002	
87,918	600	.0021	.....
102,571	700	.0026	.....
117,224	800	.0031	.....
131,877	900	.0037	.....
146,530	1,000	.0044	.0009		E (500-1,000) = 1,136,000 pounds per square inch.
161,183	1,100	.0053	E (1,000-1,500) = 898,000 pounds per square inch. Snapping sounds.
175,836	1,200	.0059	.....
190,489	1,300	.0068	.....
205,142	1,400	.0080	.....
219,795	1,500	.0091	.0028	
234,448	1,600	.0110	.....
249,101	1,700	.0141	.....
263,754	1,800	.0152	.....
278,407	1,900	.0183	.....
290,200	1,980	.....	.....		Ultimate strength.

No. 1527.

Composition: Lehigh Portland cement, 1; sand, $2\frac{1}{4}$; cinders, water, $1\frac{1}{8}$.

Marks, 5.

Age, set in air, 224 days.

Weight, $112\frac{1}{4}$ pounds = 109.8 pounds per cubic foot.

Dimensions, $12'' .00 \times 12'' .09 \times 12'' .21$.

Sectional area, 147.62 square inches.

Gauged length, 5''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,762	100	0.	0.	Initial load.
29,524	200	.0002	.....
44,286	300	.0006	.....
59,048	400	.0009	.....
73,810	500	.0014	.0001	
88,572	600	.0019	.....
103,334	700	.0024	.....
118,096	800	.0030	.....
132,858	900	.0035	.....
147,620	1,000	.0042	.0009	
162,382	1,100	.0049	E (500-1,000) = 1,250,000 pounds per square inch.
177,144	1,200	.0056	.....
191,906	1,300	.0065	.....
206,668	1,400	.0073	.....
221,430	1,500	.0084	.0023	E (1,000-1,500) = 893,000 pounds per square inch.
236,192	1,600	.0095	.....
250,954	1,700	.0106	.....
265,716	1,800	.0118	.....
280,478	1,900	.0132	Snapping sounds.
295,240	2,000	.0155	.0058	E (1,500-2,000) = 694,000 pounds per square inch.
298,600	2,020	Ultimate strength.

No. 1532.

Composition: Lehigh Portland cement, 1; sand, 3; cinders, 6; water, 2.
Marks, 1.

Age, set in air, 34 days.

Weight, 107 pounds = 105.7 pounds per cubic foot.

Dimensions: 12".05 × 12".06 × 12".03.

Sectional area, 145.08 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,508	100	0.	0.	Initial load.
29,016	200	.0001	0.	
43,524	300	.0004	0.	
58,032	400	.0009	0.	
72,540	500	.0013	.0001	
87,048	600	.0020	.0003	
101,556	700	.0027	.0005	
116,064	800	.0038	.0010	
130,572	900	.0050	.0015	
145,080	1,000	.0068	.0024	E (500-1,000) = 781,000 pounds per square inch.
159,588	1,100	.0102	.0044	
174,096	1,200	.0171	.0096	Ultimate strength.

No. 1533.

Composition: Lehigh Portland cement, 1; sand, 3; cinders, 6; water, 2.

Marks 2.

Age, set in air, 34 days.

Weight, 105½ pounds = 105.8 pounds per cubic foot.

Dimensions: 12" × 11".94 × 12".03.

Sectional area, 143.64 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,364	100	0.	0.	Initial load.
28,728	200	.0004	0.	
43,092	300	.0008	.0001	
57,456	400	.0012	.0003	
71,820	500	.0018	.0006	
86,184	600	.0023	.0006	
100,548	700	.0030	.0008	
114,912	800	.0037	.0011	
129,276	900	.0046	.0014	
143,640	1,000	.0068	.0020	E (500-1,000) = 1,000,000 pounds per square inch.
158,004	1,100	.0079	.0031	
172,368	1,200	.0106	.0045	
186,732	1,300	.0132	.0080	
191,000	1,390			Ultimate strength.

No. 1535.

Composition: Lehigh Portland cement, 1; sand, 3; cinders, 6; water, 2.

Marks, 4.

Age, set in air, 220 days.

Weight, 108 pounds=106 pounds per cubic foot.

Dimensions, 12".13 × 12".05 × 12".05.

Sectional area, 145.20 square inches.

Gauged length, 5".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,520	100	0.	0.	Initial load.
29,040	200	.0002	.....
43,560	300	.0006	.....
58,080	400	.0011	.....
72,600	500	.0018	.0002	
87,120	600	.0023	.....
101,640	700	.0029	.....
116,160	800	.0036	.....
130,680	900	.0044	.....
145,200	1,000	.0054	.0013	E (500-1,000)=1,000,000 pounds per square inch.
159,720	1,100	.0064	.....
174,240	1,200	.0073	.....
188,760	1,300	.0085	.....
203,280	1,400	.0098	.....
217,800	1,500	.0118	.0041	E (1,000-1,500)=694,000 pounds per square inch.
232,320	1,600	.0145	.....	Snapping sounds.
246,840	1,700	.0179	.....	First crack.
251,800	1,730	.....	.....	Ultimate strength.

No. 1536.

Composition: Lehigh Portland cement, 1; sand, 3; cinders, 6; water, 2.

Marks, 5.

Age, set in air, 220 days.

Weight, 105 pounds = 104 pounds per cubic foot.

Dimensions, $12''.01 \times 12'' \times 12''.10$.

Sectional area, 145.20 square inches.

Gauged length, 5".

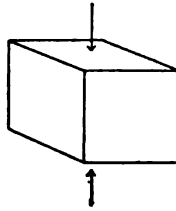
Applied loads.		In gauged length.		Remarks.	
Total.	Per square inch.	Compression.	Set.		
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>		
14,520	10000	0.	0.	Initial load.	
29,040	200	.0004	.....	
43,560	300	.0013	.....	
58,080	400	.0019	.....	
72,600	500	.0028	.0008		
87,120	600	.0037	.....	
101,640	700	.0046	.....	
116,160	800	.0055	.....	
130,680	900	.0068	.....	
145,200	1,000	.0081	.0027		E (500-1,000) = 735,000 pounds per square inch.
159,720	1,100	.0100		Snapping sounds.
174,240	1,200	.0118	.....	
188,760	1,300	.0138	.....	
203,280	1,400	.0179	.....	
217,800	1,500	.0210	.0102	E (1,000-1,500) = 463,000 pounds per square inch. First crack.	
226,400	1,560	Ultimate strength.	

TABULATION OF THE ELASTIC PROPERTIES AND COMPRESSIVE STRENGTH OF CINDER-CONCRETE CUBES.

Lehigh Portland cement used.
Cubes set in air.

No. of test.	Marks.	Composition.			Age. Days.	Weight.		Modulus of elasticity.		Permanent set after loads per square inch of—			Compressive strength per square inch.
		Cement.	Sand.	Cinders.		Water.	Total.	Per cubic foot.	Between loads per square inch of 500 and 1,000.	At highest stress observed.	500.	1,000.	
1514	1	1	2	4	11	154	111.5	Pounds.	Pounds.	Inch.	Inch.	Inch.	Pounds.
1515	2	1	2	4	38	115	111.2	1,785,000	1,136,000	.0003	.0012	.0012	1,850
1516	3	1	2	4	11	118	111.3	1,925,000	1,136,000	.0004	.0014	.0014	2,050
1517	4	1	2	4	224	112	111.3	1,471,000	1,087,000	.0004	.0010	.0010	2,000
1518	5	1	2	4	224	112	111.6	1,563,000	1,463,000	.0003	.0010	.0010	2,500
1520	1	1	2	5	88	112	109.1	1,950,000	1,492,000	.0001	.0009	.0009	1,400
1521	2	1	2	5	38	113	110.6	1,492,000	1,492,000	.0005	.0009	.0009	1,400
1524	4	1	2	5	224	110	109.5	1,535,000	893,000	.0002	.0009	.0009	1,800
1527	5	1	2	5	224	112	109.8	1,250,000	694,000	.0001	.0009	.0023	2,020
1530	1	1	3	6	34	107	105.7	751,000	.....	.0001	.0024	.....	1,200
1533	2	1	3	6	84	105	105.8	1,000,000	.....	.0005	.0020	.....	1,320
1535	4	1	3	6	220	108	108.0	1,000,000	694,000	.0002	.0013	.0041	1,730
1536	5	1	3	6	220	105	104.0	735,000	463,000	.0006	.0027	.0102	1,560

COMPRESSIVE TESTS OF MARBLE FOR THE WATERTOWN ARSENAL.



Compressed surfaces faced with plaster of Paris.

No. of test.	Description.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
		Height.	Compressed surface.				Total.	Per square inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
10584	Vermont Marble Co.....	3.98	3.97	4.12	16.36	162,800	162,800	9,950
10585	Columbian Marble Co..	4.40	4.32	4.34	18.75	179,100	179,100	9,550

Pyramidal fractures.

Analysis of Columbian marble, per label thereon:

Carbonate of lime	98.37
Carbonate of magnesia .....	.77
Carbonate of iron.....	.034
Manganese and alumina oxides.....	.005
Insoluble in acids .....	.63
Organic matter.....	.08

Coloring matter is pure carbon, graphite, which is incapable of decomposition by atmospheric agents.

PRIVATE TESTS.

TESTS MADE FOR PRIVATE PARTIES DURING THE FISCAL YEAR ENDED JUNE 30, 1903.

Date.	Material.	For whom tested.		
		Name.	City.	State.
1902.				
July 10	Plain and twisted steel bars.	Ransome Concrete Machinery Co.	New York	N. Y.
16	Concrete column.	The Norcross Brothers Co.	Boston	Mass.
Aug. 4	Cast iron	Whittier Machine Co	do	Mass.
5	Nails in wood.	J. C. Pearson Co	do	Mass.
6	Concrete	New York, New Haven and Hartford R. R.	Bridgeport	Conn.
12	Pipe coupling	The Atlas Coupling Co.	Boston	Mass.
15	Concrete	The Norcross Brothers Co	do	Mass.
16	Nails in wood.	J. C. Pearson Co	do	Mass.
28	do	do	do	Mass.
Sept. 3	do	do	do	Mass.
15	Barrel steel.	The Marlin Fire Arms Co.	New Haven	Conn.
16	Plain and twisted steel bars.	Ransome Concrete Machinery Co.	New York	N. Y.
Oct. 7	Boiler braces	G. L. Heins	Albany	N. Y.
15	S hook	The Pennsylvania Steel Co.	Steelton	Pa.
16	Corrugated steel	Boston Transit Commission	Boston	Mass.
19	Steel wire spokes.	S. R. Bailey & Co.	Amesbury	Mass.
20	Braced joint.	Dr. S. S. Carpenter.	Boston	Mass.
23	Limestone	L. W. Lewis	Ponca City	Okla.
30	Cast iron	Salem Electric Lighting Co	Salem	Mass.
31	Barrel steel.	Savage Arms Co.	Utica	N. Y.
Nov. 5	Steel wire rope	Herreshoff Manufacturing Co.	Bristol	R. I.
6	Boiler plate	Merrimac Chemical Co	Boston	Mass.
8	Steel wire rope	Herreshoff Manufacturing Co.	Bristol	R. I.
10	Braced joints.	Dr. S. S. Carpenter.	Boston	Mass.
15	Steel wire rope	Herreshoff Manufacturing Co.	Bristol	R. I.
16	do	do	do	R. I.
17	Corrugated rods in concrete.	Boston Transit Commission	Boston	Mass.
Dec. 2	Steel specimens	F. A. Houdlette & Son	do	Mass.
5	Nails in wood	J. C. Pearson Co	do	Mass.
5	Marble	Edward Miller	Seattle	Wash.
8	Nails in wood	J. C. Pearson Co.	Boston	Mass.
10	Manila rope	Fearing, Whiton & Co.	do	Mass.
16	Steel specimens	F. A. Houdlette & Son.	do	Mass.
23	Nails in wood	J. C. Pearson Co	do	Mass.
24	Granite and limestone.	City of Watertown	Watertown	N. Y.
27	Steel bar	The Marlin Fire Arms Co.	New Haven	Conn.
31	Wire rope	Herreshoff Manufacturing Co.	Bristol	R. I.
	Shackles	Fletcher & Crowell Co	Portland	Me.
1903.				
Jan. 3	Steel chain	H. I. Crandall & Son Co	East Boston	Mass.
5	Fabric.	Hood Rubber Co.	Watertown	Mass.
9	Rubber belting	Revere Rubber Co.	Chelsea	Mass.
15	Fabric.	Hood Rubber Co.	Watertown	Mass.
17	Cast iron	Golding & Co.	Boston	Mass.
21	Wrought-iron braces	H. I. Crandall & Son Co.	East Boston	Mass.
24	Sandstone cubes.	City of Cincinnati	Cincinnati	Ohio.
28	Artificial stone	H. Cordes	Detroit	Mich.
24	Nails in wood	J. C. Pearson Co	Boston	Mass.
Feb. 6	do	do	do	Mass.
7	Band knife steel	Hawkridge Brothers.	do	Mass.
17	Leather belting	Henry K. Barnes	do	Mass.
19	Wire-rope sockets	The Thomas Laughlin Co.	Portland	Me.
19	Cotton belting	Ruboll-Belting Co	Boston	Mass.
20	Steel specimens	The Atlantic Works	East Boston	Mass.
24	Babbitt metal	The Annihilator Metal Co.	Boston	Mass.
25	Granite	City of Cincinnati	Cincinnati	Ohio.
25	Aluminum wire.	Pittsburg Reduction Co.	Pittsburg	Pa.
26	Steel specimens	The Atlantic Works	East Boston	Mass.
26	Barrel steel.	The Marlin Fire Arms Co.	Hew Haven	Conn.
26	Steel specimens	Spaulding & Jennings.	Jersey City	N. J.
Mar. 3	Fabric.	Hood Rubber Co.	Watertown	Mass.
5	Marble	The Norcross Brothers Co.	Worcester	Mass.
6	Fabric.	Hood Rubber Co.	Watertown	Mass.
7	Steel specimens	The Atlantic Works.	East Boston	Mass.
12	do	do	do	Mass.
	Strain insulators.	George C. Ewing.	Boston	Mass.

TESTS MADE FOR PRIVATE PARTIES DURING THE FISCAL YEAR
ENDED JUNE 30, 1903—Continued.

Date.	Material.	For whom tested.		
		Name.	City.	State.
1903.				
Mar. 13	Barbed wire.....	The Hinchman-Renton Fire Proofing Co.	Denver.....	Colo.
18	Hemp bolt rope.....	Albert Winslow & Co.....	Boston.....	Mass.
19	Bricks.....	The American Vitriified Stone and Concrete Co.	Waverly.....	N. Y.
20	Wire rope sockets.....	J. H. Williams & Co.....	Brooklyn.....	N. Y.
	Canvas belting.....	Ruboll-Beating Co.....	Boston.....	Mass.
24	Steel plate and bars..	Pittsburgh Testing Laboratory..	Pittsburg.....	Pa.
26	Marble.....	The White Crystal Marble Co..	Gouverneur.....	N. Y.
31	Copper wire and cable	General Electric Co.....	Schenectady.....	N. Y.
Apr. 1	Rubber belting.....	Revere Rubber Co.....	Chelsea.....	Mass.
4	do.....	do.....	do.....	Mass.
14	Concrete.....	Sanford E. Thompson.....	Newton.....	Mass.
22	Limestone.....	Beaumont Marble and Supply Co.	Duluth.....	Minn.
25	Brick.....	Chas. P. Clifford.....	Milton.....	Mass.
May 6	Rubber belting.....	Revere Rubber Co.....	Chelsea.....	Mass.
	Sister hooks.....	The Thomas Laughlin Co.....	Portland.....	Me.
7	Steel boiler plate.....	Clinton Wire Cloth Co.....	Clinton.....	Mass.
9	Copper cylinders.....	The Bridgeport Brass Co.....	Bridgeport.....	Conn.
15	Cement cubes.....	Sanford E. Thompson.....	Newton.....	Mass.
23	Rubber belting.....	Revere Rubber Co.....	Chelsea.....	Mass.
	Granite.....	J. Harper Bonnell.....	New York.....	N. Y.
25	Columns.....	Lally Patent Column Co.....	Waltham.....	Mass.
	Wrought iron.....	Harold L. Bond Co.....	Boston.....	Mass.
27	Cement briquettes.....	F. E. Evatt.....	do.....	Mass.
28	do.....	Fiske & Co.....	do.....	Mass.
June 4	Brake chain.....	Boston and Maine R. R.....	do.....	Mass.
	Cotton cloth.....	Hood Rubber Co.....	Watertown.....	Mass.
5	Copper wire.....	General Electric Co.....	Schenectady.....	N. Y.
9	Shackles and links.....	The Thomas Laughlin Co.....	Portland.....	Me.
	Rubber belting.....	Revere Rubber Co.....	Chelsea.....	Mass.
15	Granite.....	Twentieth Century Granite Co..	Worcester.....	Mass.

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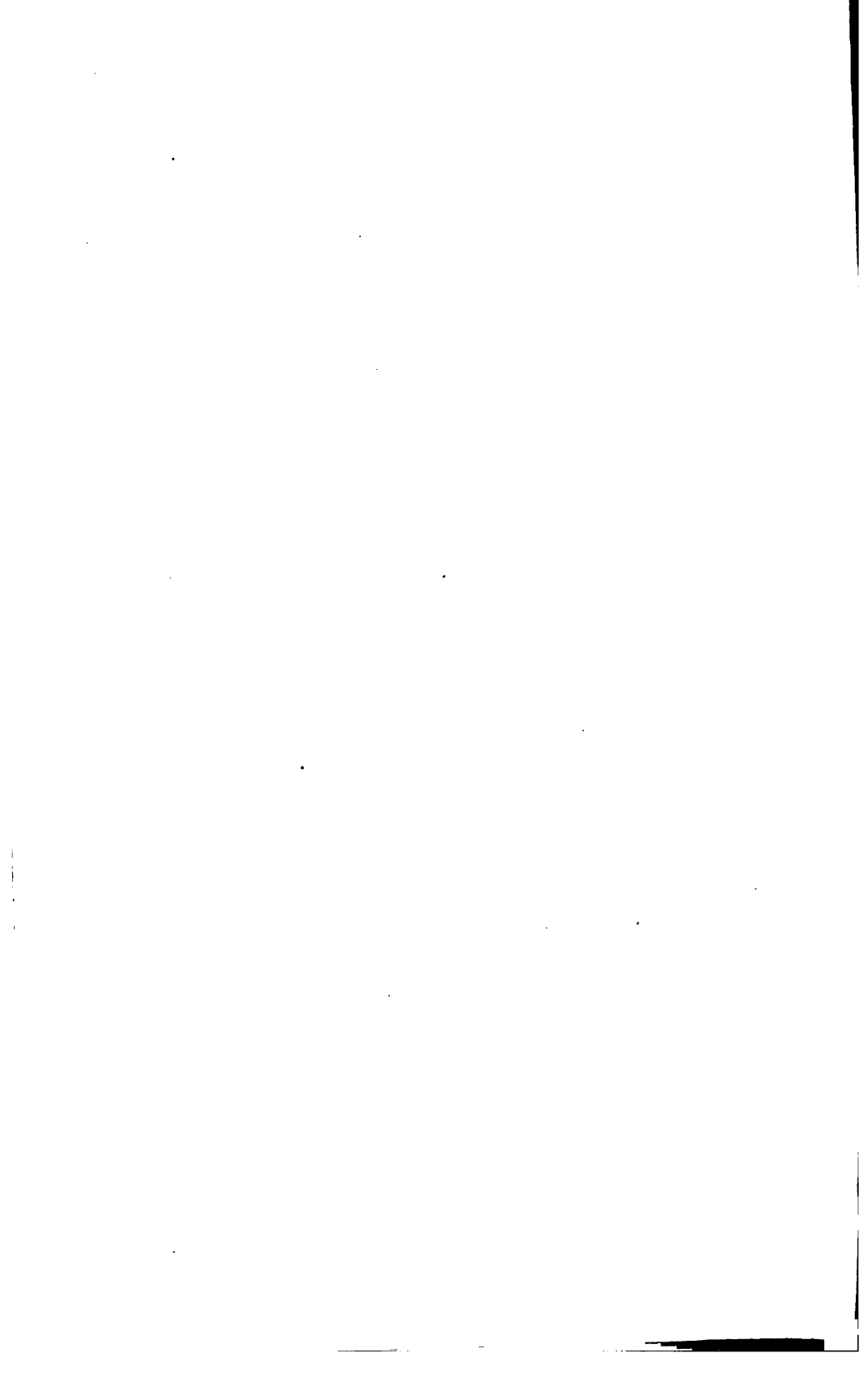
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